

III 11

SELECTED WATER RESOURCES ABSTRACTS



VOLUME 3, NUMBER 3
FEBRUARY 1, 1970

W70-00836 -- W70-01241

UNIVERSITY OF KENTUCKY
WATER RESOURCES INSTITUTE
LEXINGTON, KENTUCKY

Selected Water Resources Abstracts is published semimonthly for the Water Resources Scientific Information Center (WRSIC) by the Clearinghouse for Federal Scientific and Technical Information (CFSTI) of the Bureau of Standards, U. S. Department of Commerce. It is available to Federal agencies, contractors, or grantees in water resources upon request to: Manager, Water Resources Scientific Information Center, Office of Water Resources Research, U. S. Department of the Interior, Washington, D. C. 20240. Annual subscription is \$22.00 (domestic), \$27.50 (foreign), single copy price is \$3.00. Certain documents abstracted in this journal can be purchased from the Clearinghouse at the prices indicated in the entry. Prepayment is required.



U.S. Department of Commerce, Springfield, Va., 22151

SELECTED WATER RESOURCES ABSTRACTS

A Semimonthly Publication of the Water Resources Scientific Information Center,
Office of Water Resources Research, U.S. Department of the Interior



VOLUME 3, NUMBER 3
FEBRUARY 1, 1970

W70-00836 -- W70-01241

As the Nation's principal conservation agency, the Department of the Interior has basic responsibilities for water, fish, wildlife, mineral, land, park, and recreational resources. Indian and Territorial affairs are other major concerns of America's "Department of Natural Resources."

The Department works to assure the wisest choice in managing all our resources so each will make its full contribution to a better United States—now and in the future.

FOREWORD

Selected Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographical citation and a set of descriptors or identifiers which are listed in the **Water Resources Thesaurus** (November 1966 edition). Each abstract entry is classified into ten fields and sixty groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources. WRSIC is not presently prepared to furnish loan or retention copies of the publications announced.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several planned services of the Water Resources Scientific Information Center (WRSIC). The Center was established by the Secretary of the Interior and has been designated by the Federal Council for Science and Technology to serve the water resources community by improving the communication of water-related research results. The Center is pursuing this objective by coordinating and supplementing the existing scientific and technical information activities associated with active research and investigation program in water resources.

To provide WRSIC with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstracting, and indexing from the current and earlier pertinent literature in specified subject areas. Centers, and their subject coverage, now in operation are:

- Ground and surface water hydrology at the Water Resources Division of the U.S. Geological Survey, U.S. Department of the Interior.
- Metropolitan water resources management at the Center for Urban Studies of the University of Chicago.

- Eastern United States water law at the College of Law of the University of Florida.
- Policy models of water resources systems at the Department of Water Resources Engineering of Cornell University.
- Water resources economics at the Water Resources Research Institute of Rutgers University.
- Design and construction of hydraulic structures; weather modification; and evaporation control at the Bureau of Reclamation, Denver, Colorado.
- Eutrophication at the Water Resources Center of the University of Wisconsin, jointly sponsored by the FWPCA, Soap and Detergent Association, and the Agricultural Research Service.
- Water resources of arid lands at the Office of Arid Lands Studies of the University of Arizona.

In cooperation with the Federal Water Pollution Control Administration, the following "centers of competence" have been established:

- Thermal pollution at the Department of Sanitary and Water Resources Engineering of Vanderbilt University.
- Textile wastes pollution at the School of Textiles of North Carolina State University.
- Water quality requirements for freshwater and marine organisms at the College of Fisheries of the University of Washington.
- Wastewater treatment and management at the Center for Research in Water Resources of the University of Texas.

The input from these Centers, and from the 51 Water Resources Research Institutes administered under the Water Resources Research Act of 1964, as well as input from the grantees and contractors of the Office of Water Resources Research and other Federal water resources agencies with which the Center has agreements becomes the information base from which this journal is, and other information services will be, derived; these services include bibliographies, specialized indexes, literature searches, and state-of-the-art reviews.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
Office of Water Resources Research
U.S. Department of the Interior
Washington, D. C. 20240

CONTENTS

FOREWORD	iii
-----------------	-----

SUBJECT FIELDS AND GROUPS

(Use Edge Index on back cover to Locate Subject Fields and Indexes in the journal.)

01 NATURE OF WATER

Includes the following Groups: Properties; Aqueous Solutions and Suspensions

02 WATER CYCLE

Includes the following Groups: General; Precipitation; Snow, Ice, and Frost; Evaporation and Transpiration; Streamflow and Runoff; Groundwater; Water in Soils; Lakes; Water in Plants; Erosion and Sedimentation; Chemical Processes; Estuaries.

03 WATER SUPPLY AUGMENTATION AND CONSERVATION

Includes the following Groups: Saline Water Conversion; Water Yield Improvement; Use of Water of Impaired Quality; Conservation in Domestic and Municipal Use; Conservation in Industry; Conservation in Agriculture.

04 WATER QUANTITY MANAGEMENT AND CONTROL

Includes the following Groups: Control of Water on the Surface; Groundwater Management; Effects on Water of Man's Non-Water Activities; Watershed Protection.

05 WATER QUALITY MANAGEMENT AND PROTECTION

Includes the following Groups: Identification of Pollutants; Sources of Pollution; Effects of Pollution; Waste Treatment Processes; Ultimate Disposal of Wastes; Water Treatment and Quality Alteration; Water Quality Control.

06 WATER RESOURCES PLANNING

Includes the following Groups: Techniques of Planning; Evaluation Process; Cost Allocation, Cost Sharing, Pricing/Repayment; Water Demand; Water Law and Institutions; Nonstructural Alternatives; Ecologic Impact of Water Development.

07 RESOURCES DATA

Includes the following Groups: Network Design; Data Acquisition; Evaluation, Processing and Publication.

08 ENGINEERING WORKS

Includes the following Groups: Structures; Hydraulics; Hydraulic Machinery; Soil Mechanics; Rock Mechanics and Geology; Concrete; Materials; Rapid Excavation; Fisheries Engineering.

09 MANPOWER, GRANTS, AND FACILITIES

Includes the following Groups: Education—Extramural; Education—In-House; Research Facilities; Grants, Contracts, and Research Act Allotments.

10 SCIENTIFIC AND TECHNICAL INFORMATION

Includes the following Groups: Acquisition and Processing; Reference and Retrieval; Secondary Publication and Distribution; Specialized Information Center Services; Translations; Preparation of Reviews.

SUBJECT INDEX

AUTHOR INDEX

ORGANIZATIONAL INDEX

ACCESSION NUMBER INDEX

ABSTRACT SOURCES

SELECTED WATER RESOURCES ABSTRACTS

02. WATER CYCLE

2A. General

A LABORATORY STUDY OF SURFACE RUNOFF DUE TO MOVING RAINSTORMS,
Illinois Univ., Urbana.
Ben Chie Yen, and Ven Te Chow.
NSF Grant GK-1155. Water Resources Res, Vol 5, No 5, p 989-1006, Oct 1969. 18 p, 7 fig, 13 ref.

Descriptors: *Rainfall-runoff relationships, *Runoff forecasting, *Rainfall disposition, Hydrographs, Hydrograph analysis, Dimensional analysis, Distribution patterns, Mathematical models.
Identifiers: Moving rainstorms, Rainfall distribution.

The movement of a rainstorm determines the spatial and temporal distributions of the rainfall over a watershed and hence affects the characteristics of the flow on the watershed. In this study the importance of the movement of rainstorms on the time distribution of the surface runoff from watersheds is demonstrated through the use of a laboratory watershed experimental system. Experiments were performed on the impervious square watershed for 2 rainfall intensities, 4 surface slopes, and 14 rainstorm velocities. Analysis of the mechanics of water flowing on watersheds is attempted to explain the influence of movement of rainstorms on the characteristics of surface runoff hydrographs. (Knapp-USGS)
W70-00839

A MODEL FOR RAINFALL ROUTING DURING INITIAL ABSTRACTION,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Plant Industry.
F. X. Dunin.
J Hydrol, Vol 9, No 1, p 57-72, Sept 1969. 16 p, 5 tab, 9 ref.

Descriptors: *Rainfall-runoff relationships, *Routing, *Runoff forecasting, *Mathematical models, Model studies, Infiltration, Water storage, On-site tests, Drainage, Percolation, Simulation analysis.
Identifiers: *Rainfall routing, Australia.

More reliable estimation of runoff requires the development of a model to simulate rainfall disposition prior to runoff production on rural catchments. A mathematical model based on the moisture storage capacities of the upper and subsoil zones of a catchment was developed. Its general form was confirmed by comparison of predicted values with recorded data on initial abstraction from 4 pastoral catchments on texture-contrast soils with heavy clay subsoils at the Parwan Experimental Area, near Bacchus Marsh, Victoria, Australia. The modifications necessary for extending this model to ungauged areas are elaborated and changes in the elements of the model following pasture improvement are discussed. (Knapp-USGS)
W70-00844

EFFECT OF RAINFALL VARIABILITY ON STREAMFLOW SIMULATION,
Geological Survey, Menlo Park, Calif. Water Resources Div.
D. R. Dawdy, and J. M. Bergman.
Water Resources Res, Vol 5, No 5, p 958-966, Oct 1969. 9 p, 3 fig, 2 tab, 2 ref.

Descriptors: *Rainfall-runoff relationships, *Statistical methods, *Mathematical models, *Variability, Correlation analysis, Simulation analysis, Evaporation, Hydraulic conductivity, Soil moisture, Infiltration, Routing, Streamflow forecasting.
Identifiers: *Rainfall variability.

Three recording rain gages in a 9.7-square mile basin in southern California were used with a deter-

ministic rainfall-runoff model to simulate flood hydrographs and peaks and to assess the effects of data errors on simulation results. Bias in the estimation of effective basin rainfall seemed to result in curve fitting parameter adjustments which compensated for the bias. The combined effects for a storm of both difference in the time distribution of rainfall at different points and spatial variability of rainfall volume over the basins limit the possible accuracy of simulation results. The use of a single rain gage on a basin with this hydrology can at best be expected to predict peak discharge with a standard error of estimate on the order of 20%. (Knapp-USGS)
W70-00850

CONTINUOUS HYDROGRAPH SYNTHESIS WITH AN API-TYPE HYDROLOGIC MODEL,
Weather Bureau, Silver Spring, Md.
Walter T. Sittner, Charles E. Schauss, and John C. Monro.
Water Resources Res, Vol 5, No 5, p 1007-1022, Oct 1969. 16 p, 12 fig, 2 tab, 1 ref.

Descriptors: *Rainfall-runoff relationships, *Mathematical models, *Streamflow forecasting, Hydrograph analysis, Synthetic hydrology, Recession curves, Unit hydrographs, Groundwater movement, Antecedent precipitation, Flood forecasting, Simulation analysis.
Identifiers: Hydrologic models, Synthetic hydrographs.

The U.S. ESSA Weather Bureau Hydrologic Research and Development laboratory has developed a complete hydrologic model utilizing an antecedent precipitation index (API) type rainfall-runoff relation to compute surface runoff. With increasing demand for continuous river forecasts as well as flood forecasts, it is necessary to have a model that will predict all components of flood as functions of observable independent parameters on a continuous basis. To formulate the model, existing and proved techniques were used where possible and new techniques developed as necessary. The model consists of 4 basic parts: a relation for computing groundwater recession, a method of computing the groundwater flow hydrograph as a function of the direct runoff hydrograph, an API-type rainfall-runoff relation, and a unit hydrograph. The rainfall-runoff relation is of the incremental type, yielding a runoff computation for each 6-hr period rather than computing the total storm runoff. This has been accomplished through the inclusion of a new parameter, retention index. Two important features of the model are the ease of adjusting parameters to observed flow and the sequential development of the 4 basic parts with a minimum of interaction. (Knapp-USGS)
W70-00860

A CONJUNCTIVE OPERATION OF A SURFACE RESERVOIR AND A GROUNDWATER AQUIFER,
Technion - Israel Inst. of Tech., Haifa.
Nathan Buras.

World Meteorol Organ Int Ass Sci Hydrol Symp, Berkeley, p 492-500, Aug 1963. 9 p, 1 fig, 2 tab, 9 ref.

Descriptors: *Dynamic Programming, *Optimization, *Aquifers, *Surface-groundwater relationships, *Decision making, Reservoir operation, Pumping, Water loss, Water demand, Water supply, Mathematical models.
Identifiers: Lake Tiberias.

A conceptual framework was developed for the problem of operating surface storage facilities in conjunction with groundwater aquifers. The problem of operating the system had two aspects (a) the operation of the reservoir (Lake Tiberias) and of the aquifer so as to minimize losses of water and (b) the supply of water to satisfy demands at minimum cost of pumping. The complex physical system was reduced to a simplified mathematical model which was cast as a problem in sequential

decision making. This problem was analyzed using the method of dynamic programming and indicating the form of computational solution. The optimization criterion involved the determination of costs connected with the delivery of water and of penalties for not meeting demands. (Thiuri-Cornell)
W70-00906

LINEAR PROGRAMMING FOR HYDROLOGIC ANALYSES,
Michigan Univ., Ann Arbor.
Rolf A. Deininger.
Water Resources Res, Vol 5, No 5, p 1105-1109, Oct 1969. 5 p, 1 fig, 2 tab, 6 ref.

Descriptors: *Mathematical studies, *Linear programming, *Mathematical models, Simulation analysis, Least squares method, Hydrograph analysis.
Identifiers: Hydrologic models.

The estimation of the parameters of hydrologic models often poses difficulties since nonnegativity requirements, inequalities, and other constraints limit the use of standard statistical analyses. The use of linear programming techniques to estimate the parameters based on the criteria of minimum absolute deviations and on minimum maximum deviations appears to be advantageous since well-established algorithms and computer programs exist. (Knapp-USGS)
W70-00999

CONSTRUCTION OF A MULTILEVEL SCHEME STABLE IN RELATION TO INITIAL DATA FOR SHORT-RANGE WEATHER FORECAST (RUSSIAN),
For primary bibliographic entry see Field 02B.
W70-01015

STATISTICAL STRUCTURE OF VERTICAL HUMIDITY PROFILES (RUSSIAN),
For primary bibliographic entry see Field 02B.
W70-01016

ADAPTION OF AIR TEMPERATURE FIELD TO WATER TEMPERATURE FIELD (RUSSIAN),
N. T. Glinsky, V. F. Baklanovskaya, and R. D. Gasanova.

Izvestia Akad Nauk, SSSR, Fizika Atmosfery i Okeana, Vol 4, No 11, p 1214-1219, Nov 1968. 5 fig, 13 ref.

Descriptors: *Air temperature, *Water temperature, Mathematical studies, Mapping, Atmosphere, Air circulation, Water circulation, Seasonal, Turbulence, Heat exchangers, Radiation, Winds, Density, Velocity.
Identifiers: North Atlantic, Air-water temperature relations.

The relationship between air temperature and water temperature was investigated on the basis of the solution of a second order partial differential equation applied to the selected meteorological and hydrological data collected in the North Atlantic, assuming that the coefficients of turbulence of each air layer are constant. The propagation of a temperature disturbance in water and the air takes place with equal velocity, indicating that the temperature changes in an over-the-water air layer closely follow the water temperature changes. (Gabriel-USGS)
W70-01017

NONLINEAR THEORY OF WIND DRIFT OF ICE (RUSSIAN),
Akademija Nauk SSSR. Institut Okeanologii.
For primary bibliographic entry see Field 02C.
W70-01018

Field 02—WATER CYCLE

Group 2B—Precipitation

2B. Precipitation

MEASURING RAINFALL ON FOREST CATCHMENTS,

Monash Univ., Clayton (Australia). Dept. of Mechanical Engineering.

R. J. DeLaine.

J Hydrol, Vol 9, No 1, p 103-112, Sept 1969. 10 p, 1 fig, 3 ref.

Descriptors: *Rainfall, *Rain gages, *Networks, Stemflow, Interception, Forests, Instrumentation, Runoff forecasting, Rainfall-runoff relationships.

Identifiers: Forested catchments, Rain gaging.

Some principles based on field experience are given for planning a network of rain gages to give the greatest amount of information for a given amount of effort and equipment. Several ways of measuring rainfall above and below trees are described. In forest country where gaging is difficult, or in steep open country, or for any long term project, it is better to start with a pilot survey, using about 30% to 40% of the gages. This will give an idea of the variations in rainfall over the area, and will provide useful information to position the remaining gages. (Knapp-USGS)

W70-00843

A MODEL FOR RAINFALL ROUTING DURING INITIAL ABSTRACTION,

Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Plant Industry.

For primary bibliographic entry see Field 02A.

W70-00844

SEASONAL VARIATION IN RAIN GAGE CATCH,

Agricultural Research Service, Cochocton, Ohio. Soil and Water Conservation Research Div.; and Weather Bureau, Akron, Ohio. Eastern Region.

J. L. McGuinness, and Grant W. Vaughn.

Water Resources Res, Vol 5, No 5, p 1142-1146, Oct 1969. 5 p, 2 fig, 2 tab, 11 ref.

Descriptors: *Rain gages, *Lysimeters, Seasonal, Rainfall, Precipitation (Atmospheric), Calibrations, Climates, Meteorology, Interception, Ohio. Identifiers: Rain gage catch variations.

In northern Ohio 8-inch standard rain gages consistently caught more precipitation in summer and less in winter than adjacent digital punch gages although average annual totals were almost identical. A similar seasonal pattern was found in a comparison of precipitation catch by weighing lysimeters and adjacent weighing-type recording rain gages in Ohio and in a comparison of standard and recording rain gage catch in Nebraska. Some reasons for the differences in their implications are discussed. (Knapp-USGS)

W70-00854

CONTINUOUS HYDROGRAPH SYNTHESIS WITH AN API-TYPE HYDROLOGIC MODEL,

Weather Bureau, Silver Spring, Md.

For primary bibliographic entry see Field 02A.

W70-00860

ON THE POSSIBILITY OF ESTIMATING THE THICKNESS OF UNCONSOLIDATED ROCKS BY VERTICAL ELECTRICAL SOUNDING IN PERMAFROST AREAS (RUSSIAN),

Vsesoyuzny Nauchno-Issledovatel'skii Institut Geofizicheskikh Metodov Razvedki, Moscow (USSR).

For primary bibliographic entry see Field 07B.

W70-00878

THE CLIMATE OF CITIES: A SURVEY OF RECENT LITERATURE,

National Air Pollution Control Administration, Raleigh, N.C.

For primary bibliographic entry see Field 10. W70-00988

CONSTRUCTION OF A MULTILEVEL SCHEME STABLE IN RELATION TO INITIAL DATA FOR SHORT-RANGE WEATHER FORECAST (RUSSIAN),

V. M. Kadyshnikov.

Izvestiya Akad Nauk, SSSR, Fizika Atmosfery i Okeana, Vol 4, No 11, p 1139-1148, Nov 1968. 3 fig, 17 ref.

Descriptors: *Weather forecasting, *Mathematical models, Temperature, Gravity, Atmospheric pressure, Atmosphere, Mathematical studies, Altitude, Mapping, Cyclones, Anticyclones.

Identifiers: Multilevel-pattern numerical weather forecasting.

By assuring quasi-static and adiabatic conditions, hydrodynamic equations are given. Atmospheric geopotentials and temperatures are a function of velocity, gravity, atmospheric pressure, and gas constant. To achieve reliable short-range weather forecasting, the atmospheric space was subdivided into n layers and certain end conditions were assumed. The application of the Taylor series and matrix techniques leads to final results which can be evaluated by solving the Laplace and Helmholtz equations. An example is given of surface pressure forecasting by means of a S-level prognostic pattern satisfying the necessary requirements. (Gabriel-USGS)

W70-01015

STATISTICAL STRUCTURE OF VERTICAL HUMIDITY PROFILES (RUSSIAN),

V. S. Komarov.

Izvestiya Akad Nauk, SSSR, Fizika Atmosfery i Okeana, Vol 4, No 11, p 1160-1168, Nov 1968. 2 tab, 14 ref.

Descriptors: *Humidity, *Atmosphere, *Mathematical models, Statistical models, Seasonal, Meteorology, Forecasting, Heat balance, Energy budget, Altitude, Temperature, Geophysics, Radiosondes.

Identifiers: *USSR.

The mean values, standard deviations, and autocorrelation functions of the vertical structure of the humidity fields at Voyeykovo Tashkent, Kzyl-Orda and Nagayev of the USSR were evaluated on the basis of radiosonde data and the application of statistical and matrix methods. The effect of physico-geographical and seasonal factors on the autocorrelation function characteristics is briefly analyzed. (Gabriel-USGS)

W70-01016

WEATHER PATTERNS IN SOUTHERN WEST PAKISTAN,

Clark Univ., Worcester, Mass. Graduate School of Geography.

Rodman E. Snead.

Available from the Clearinghouse as AD-685 975, \$3.00 in paper copy, \$0.65 in microfiche. Archiv fur Meteorologie, Geophysik und Bioklimatologie, ser B, Vol 16, p 316-346, 1968. 31 p, 7 fig, 7 tab, 42 ref.

Descriptors: *Arid lands, *Meteorology, *Weather patterns, *Meteorological data, Anticyclones, Precipitation (Atmospheric), Synoptic analysis, Seasonal, Rainfall disposition, Storms, Monsoons, Convection.

Identifiers: *West Pakistan, *Subsidence (Atmospheric), Arabian Sea, Depressions (Atmospheric).

The region studied is of particular interest as a transition zone between the mediterranean type

winter rainfall to the west and monsoon summer rainfall to the east. As a result Southern West Pakistan receives scanty, unreliable rainfall averaging less than 10 inches per year, resulting in a very arid land. Six main patterns of weather were identified and the reasons for their occurrence are described using a method of synoptic comparison of the characteristics associated with each weather type. The types are: subtropical anticyclone pattern, winter cyclone storms, modified monsoon pattern, and eastern depressions. The synoptic characteristics of each are presented. Located in a transition zone between these different patterns, the area receives only the dying effects of each. The author concludes that it is remarkable that any moisture reaches the area since subtropical, anticyclone air is not conducive to the upward movement and resulting condensation of moisture. (Crouse-Arizona)

W70-01197

NOCTURNAL AIR TEMPERATURE ON A FORESTED MOUNTAIN SLOPE,

Forest Service (USDA), Fort Collins, Colo. Rocky Mountain Forest and Range Experiment Station.

James D. Bergen.

USDA Forest Serv Res Pap RM-52, 1969. 12 p, illus.

Descriptors: *Air temperature, *Mountain forests, *Climatology, Isotherms, Microclimatology, Forestry, Nocturnal temperatures, Meteorology, Heat budget, Thermodynamics, Frost protection, Cooling.

Identifiers: *Forest temperatures.

Profiles of air temperature on a forested mountain slope show an inversion below the top of the tree canopy. The slope tends to cool with constant down-slope temperature gradient in the early part of the night; gradients increase in the later hours. Plots of potential temperature indicate, for some nights, a point of almost constant temperature halfway up the hillside. This point can be identified with a center of divergence for cold air moving off the slope. The potential temperature deficit relative to the temperature at this point shows approximate similarity between vertical profiles at the different stations when the profiles are scaled by the height of the first inversion above the slope and the average potential temperature deficit below that inversion.

W70-01219

SOME OBSERVATIONS OF CLOUD INITIATION IN INDUSTRIAL AREAS,

Public Health Service, Washington, D.C.

For primary bibliographic entry see Field 05C.

W70-01240

2C. Snow, Ice, and Frost

TOTAL ALBEDO OF GREAT LAKES ICE,

United States Lake Survey, Detroit, Mich.

S. J. Bolsenga.

Water Resources Res, Vol 5, No 5, p 1132-1133, Oct 1969. 2 p, 1 tab, 6 ref.

Descriptors: *Albedo, *Ice, *Great Lakes, *Lake ice, Slush, Climatology.

Identifiers: Brash ice, Pancake ice.

The total (0.3-3.0 micron) albedo of various types of ice common to the Great Lakes ranged from 10% for clear ice to 46% for snow ice at solar altitudes ranging from 32 to 40 degrees. Explanations are given for similarities between the albedo of pancake (31%) and slush curd ice (32%), and slush (41%) and brash ice (41%). (Knapp-USGS)

W70-00851

WATER TEMPERATURE DURING THE MELTING OF LAKE ICE,

National Research Council of Canada, Ottawa (Ontario).

WATER CYCLE—Field 02

Streamflow and Runoff—Group 2E

For primary bibliographic entry see Field 02H.
W70-00852

GLACIAL HISTORY AND MORPHOLOGY OF WEST SWEDEN (SWEDISH), Lund Univ. (Sweden). Geographical Inst.

Ake Hillefors.

SUMMARIES OF EACH SECTION OF TEXT ARE GIVEN IN ENGLISH. MEDD FRAN LUNDS UNIV GEOGR INST, AVHANDLINGAR NO 60, 1969. 319 P, 214 FIG, 1 MAP, 410 REF.

Descriptors: *Glaciation, *Glaciers,
*Geomorphology, Geology, Animal populations, Plant populations, Ice, Ice breakup, Till, Stratigraphy, Marine geology, Deltas, Climates, Radioactive dating, Erosion, Sediment transport, Rocks. Identifiers: *Sweden, West Sweden glaciated area.

A comprehensive study is compiled of the glacial history and morphology of the West Sweden area based on the author's field work and 410 earlier publications. The discussion includes: (1) rocks and morphology; (2) the Dosebacka formations (inner construction and genesis); (3) ice movements in West Sweden; (4) the moraine (Forms, inner construction, and probable genesis); (5) the glaciofluvial material (morphology, inner construction, and probable genesis); (6) studies of the marine limit; (7) the ice recession; and (8) the late-glacial climate of West Sweden. (Gabriel-USGS)
W70-00998

CERTAIN ASPECTS OF ENGINEERING GEOLOGY IN PERMAFROST, Army Terrestrial Sciences Center, Hanover, N.H.

For primary bibliographic entry see Field 08D.

W70-01011

NONLINEAR THEORY OF WIND DRIFT OF ICE (RUSSIAN), Akademiya Nauk SSSR. Institut Gidrologii.

D. L. Laykhman.

Izvestia Akad Nauk, SSSR, Fizika Atmosferы i Okeana, Vol 4, No 11, p 1220-1224, Nov 1968. 2 fig, 1 tab, 5 ref.

Descriptors: *Ice, *Drifting (Aquatic), *Wind velocity, *Mathematical models, *Mathematical studies, Velocity, Stress, Turbulent flow, Viscosity, Roughness coefficient, Roughness (Hydraulic). Identifiers: Ice drift (Wind-driven).

The phenomenon of wind drift of ice was analytically investigated using an ice-motion equation, assuming certain limiting conditions. With the increase of the Rossby number for the upper surface of the ice, the wind coefficient is increased. If the ratio of the upper roughness to the lower roughness increases, the coefficient of roughness increases. Ice drift deviates from an isobar up to 50% in the direction of higher pressure, with the small deviation angles associated with the large Rossby numbers. (Gabriel-USGS)
W70-01018

STRENGTH TEST ON NEWLY FALLEN SNOW, Forest Service (USDA), Salt Lake City, Utah. Alta Avalanche Study Center.

For primary bibliographic entry see Field 07B.

W70-01221

2D. Evaporation and Transpiration

A NUMERIC METHOD FOR ESTIMATING INFILTRATION, REDISTRIBUTION, DRAINAGE, AND EVAPORATION OF WATER FROM SOIL, Utah State Univ., Logan; Illinois Univ., Urbana; and Colorado State Univ., Fort Collins.

For primary bibliographic entry see Field 02G.

W70-00862

AN EMPIRICAL METHOD FOR ESTIMATING MONTHLY POTENTIAL EVAPOTRANSPIRATION IN NEVADA,

Agricultural Research Service, Fresno, Calif. Soil and Water Conservation Research Div.; and Nevada Univ., Reno. Desert Research Inst. Jerold J. Behnke, and George B. Maxey. J Hydrol, Vol 8, No 4, p 418-430, Aug 1969. 13 p, 4 fig, 3 tab, 11 ref.

Descriptors: *Evaporation, *Nevada, Arid lands, Lysimeters, Estimating, Evaporation pans, Climates, Topography, Weather, Solar radiation, Evapotranspiration.

Identifiers: Thornthwaite evapotranspiration.

Monthly potential evapotranspiration values were obtained for several stations throughout the State of Nevada using the Thornthwaite and Olivier equations. The Olivier equation correlated well with lysimeter and adjusted pan data as an estimate of ET. On an annual basis the Thornthwaite equation was approximately 50% too low. A technique was developed to estimate wet bulb depression from temperature data. This made it possible to solve the Olivier equation using only temperature data as input. Climatic conditions in Nevada were such that it was possible to apply the dry adiabatic lapse rate to a centrally located base station to obtain temperature values for other locations lacking climatic data. On a monthly basis, this 'modified' Olivier equation correlated satisfactorily with the original equation for Nevada locations ranging in elevation from 2171 to 5136 ft and in latitude from 36 deg to 41 deg N. (Knapp-USGS)
W70-01004

2E. Streamflow and Runoff

A LABORATORY STUDY OF SURFACE RUNOFF DUE TO MOVING RAINSTORMS, Illinois Univ., Urbana.

For primary bibliographic entry see Field 02A.
W70-00839

AN ESTIMATION OF WIND EFFECTS ON DISPERSION IN WIDE CHANNELS, Hydroynamics, Inc., Laurel, Md.

Jin Wu. Water Resources Res, Vol 5, No 5, p 1097-1104, Oct 1969. 7 p, 5 fig, 1 tab, 9 ref. OWRR Proj C-1290.

Descriptors: *Dispersion, *Winds, *Open channel flow, *Mixing, Waste dilution, Turbulence, Diffusion, Steady flow, Convection.

Identifiers: Turbulent shear flow.

The longitudinal dispersion coefficient in a wide channel is calculated under various combinations of streamflow and wind conditions. The effect of wind, which produces drift currents in the stream, on dispersion has hitherto been neglected. The results obtained, especially the difference in dispersion coefficients obtained under upstream and downstream wind conditions, may partially explain the wide scatter of field data. This difference further indicates the importance of choosing the ejection site on the basis of the prevailing wind conditions and of considering environmental conditions beyond stream factors alone. (Knapp-USGS)
W70-00842

A MODEL FOR RAINFALL ROUTING DURING INITIAL ABSTRACTION,

Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Plant Industry.

For primary bibliographic entry see Field 02A.

W70-00844

EFFECT OF RAINFALL VARIABILITY ON STREAMFLOW SIMULATION, Geological Survey, Menlo Park, Calif. Water Resources Div.

For primary bibliographic entry see Field 02A.
W70-00850

FLOOD PLAIN INFORMATION, TROUT AND BIJOU CREEKS, SOUTH LAKE TAHOE, CALIFORNIA.

Corps of Engineers, Sacramento, Calif.

For primary bibliographic entry see Field 04A.
W70-00856

CONTINUOUS HYDROGRAPH SYNTHESIS WITH AN API-TYPE HYDROLOGIC MODEL, Weather Bureau, Silver Spring, Md.

For primary bibliographic entry see Field 02A.

W70-00860

A STUDY OF HOT WIRE AND HOT FILM ANEMOMETERS IN WATER (FRENCH), Centre National de la Recherche Scientifique, Marseille (France); and Aix-Marseille Univ. (France). Institut de Mecanique des Fluides.

For primary bibliographic entry see Field 07B.
W70-00868

NON-LINEAR FREE SURFACES IN OPEN CHANNELS (FRENCH), Centre National de la Recherche Scientifique, Chatillon-sous-Bagnoles (France). Centre de Calcul Analogique.

For primary bibliographic entry see Field 08B.
W70-00871

PROPAGATION OF WAVE-FRONTS IN WIDE CHANNELS OF ARBITRARY CROSS-SECTION, Leeds Univ. (England).

For primary bibliographic entry see Field 08B.

W70-00872

A WATER YIELD MODEL DERIVED FROM MONTHLY RUNOFF DATA, Office of Tributary Area Development, Knoxville, Tenn.

For primary bibliographic entry see Field 03B.
W70-00905

NATURAL FEATURES CAUSED BY A CATASTROPHIC STORM IN NELSON AND AMHERST COUNTIES, VIRGINIA., Department of Conservation and Economic Development, Richmond, Va. Div. of Mineral Resources.

Virginia Minerals, Spec Issue, Oct 1969. 19 p, 28 fig, 1 map, 3 ref.

Descriptors: *Storms, *Virginia, *Appalachian Mountain Region, *Hurricanes, *Damages, Erosion, Floods, Landslides, Disasters, Storm runoff, Rain.

Identifiers: Hurricane Camille (1969).

Torrential rains associated with hurricane Camille dumped up to 27 inches of water during the night of Aug. 19-20, 1969 on portions of Nelson, Amherst, and adjoining counties, Virginia. The severe storm centered in the headwaters of the Tyee and Rockfish Rivers and their tributaries. Abnormal amounts of rainfall have been reported from the Clifton Forge area in the western portion of the State, eastward. Considerable rain fell on the western slope of the Blue Ridge in the South River watershed. All the above mentioned streams are in the James River basin, and the flood damage extended through Richmond, eastward. Massive landslides of the debris-avalanche type moved soil, boulders, and trees to create chutes and channels that extend from the foot of the steep mountainous slopes to the mountain crests. Alluvial, rubble, and debris fans were formed, and extreme high water occurred in the lower reaches of the valleys to cause extensive property damage and loss of life. Dr. John T. Hack, U.S. Geological Survey, concluded that severe rainstorms are recurring

Field 02—WATER CYCLE

Group 2E—Streamflow and Runoff

phenomena and are an important factor in the erosion and formation of the central Appalachian mountain landscape. (Knapp-USGS)
W70-00992

STORAGE YIELD: EXTENDING THE SEQUENT PEAK ALGORITHM TO MULTIPLE RESERVOIRS,
Water Resources Engineers, Inc., Springfield, Va.
For primary bibliographic entry see Field 06A.
W70-01000

EFFECT OF CHANGES OF STREAMFLOW REGIMEN ON RESERVOIR YIELD,
State Univ. of New York, Syracuse. Water Resources Center.
For primary bibliographic entry see Field 04A.
W70-01001

MEASUREMENT OF COLUMBIA RIVER FLOW TIME FROM HANFORD REACTORS TO ASTORIA, OREGON-SUMMER 1966,
Oregon State Univ., Corvallis.
Peter J. Hanson, and William O. Forster.
Water Resources Res, Vol 5, No 5, p 1129-1131, Oct 1969. 3 p, 1 fig, 6 ref.

Descriptors: *Streamflow, *Tracers, *Columbia River, *Tracking techniques, Chromium, Discharge (Water), Path of pollutants, Radioactive wastes, Waste dilution, Sampling.
Identifiers: Chromium radioisotopes, Water-mass tracers.

Chromium-51 induced in the Hanford production reactors was used to measure Columbia River flow times between the reactors and Astoria, Oregon. This opportunity came during the summer of 1966 when all reactors were inoperative for the first time in 22 yr. Chromium-51, introduced into the river as chromate anion tends to remain in solution, thus providing a suitable water-mass tracer. The complex inverse relationship of flow time to volume discharge is seen in our values of 12 days flow time from the reactors to Astoria, Oregon, during an average discharge of 290,000 cfs and 19 days flow time at a low volume discharge of 13,000 cfs. Such short travel time could be critical in the event of an accidental release into the river of extremely hazardous levels of radioactivity. (Knapp-USGS)
W70-01002

SPATIALLY VARIED FLOW EQUATIONS,
Illinois Univ., Urbana.
Ven Te Chow.
Water Resources Res, Vol 5, No 5, p 1124-1128, Oct 1969. 5 p, 5 ref.

Descriptors: *Overland flow, *Mathematical studies, Steady flow, Unsteady flow, Discharge (Water), Mathematical models, Open channel flow, Equations, Hydrodynamics.
Identifiers: Spatially varied overland flow.

The momentum and energy principles are equally applicable in the derivation of spatially varied flow equations. By applying the energy principle and introducing a slope of given energy head, the resulting spatially varied flow equation takes a different form of several terms containing the slope and the effect of added or extracted discharge from the equation derived by applying the momentum principle and using the frictional slope. The two slopes, however, become identical if the flow is steady. The spatially varied flow equation is the same for flow with either increasing or decreasing discharge. (Knapp-USGS)
W70-01003

FREQUENCY DISTRIBUTIONS OF STREAM LINK LENGTHS,
Princeton Univ., N.J. Dept. of Statistics.
For primary bibliographic entry see Field 02J.
W70-01006

THE LAKE MISSOULA FLOODS AND THE CHANNELED SCABLAND,
Chicago Univ., Ill. Dept. of the Geophysical Sciences.
For primary bibliographic entry see Field 02J.
W70-01012

STOCHASTIC METHODS FOR ANALYZING RIVER BASIN SYSTEMS,
Cornell Univ., Ithaca, N.Y. Dept. of Water Resources Engineering.
For primary bibliographic entry see Field 06A.
W70-01085

FREQUENCY ANALYSES OF FLOODS AND DROUGHTS,
Irrigation and Water Supply Commission, Queensland.
J. K. G. Ward.
Inst Eng, Aust Civ Eng Trans, Vol CE 10, No 1, p 7-14, Apr 1968. 8 p, 6 fig, 4 tab, 25 ref, disc.

Descriptors: Reservoirs, Reservoir storage, Streamflow, Foreign design practices, Streamflow forecasting, *Flood forecasting, Flood peaks, Peak discharge, Flood hydrographs, *Floods, *Droughts, Statistical analysis, Probability, Drainage basins, River flow, Hydrology, Bibliographies.
Identifiers: *Flood frequency, Flood hydrology, *Drought frequency curves, Australia.

Probability analysis of floods and droughts is of uncertain usefulness because of the unpredictability of sample errors and scarcity of field data. However, probability studies provide a valuable addition to hydrologic assessments and should be used whenever possible. A method is presented for statistical analysis of floods and droughts for rivers having reasonably long streamflow records. Results of these analyses can be applied to ungaged streams for flood frequency predictions. Flood probability predictions on ungaged catchment areas must be used with extreme caution because parameters identifying the similarity of catchment areas are difficult if not impossible to define. If used with caution, the method can provide valuable results and allow preliminary hydrologic estimates for feasibility studies of proposed dams. Drought analyses give additional data for storage behavior, assessing desirability of constructing a reservoir, issuing stream pumping licenses, and indicating low flow periods for construction purposes. (USBR)
W70-01120

INCREASES IN MAXIMUM STREAM TEMPERATURES AFTER SLASH BURNING IN A SMALL EXPERIMENTAL WATERSHED,
Forest Service (USDA), Portland, Oreg. Pacific Northwest Forest and Range Experiment Station.
For primary bibliographic entry see Field 07C.
W70-01220

2F. Groundwater

GROUNDWATER MOVEMENT TOWARD ARTIFICIAL CUTS,
North Carolina State Univ., Raleigh.
Abdel-Aziz I. Kashef.
Water Resources Res, Vol 5, No 5, p 1032-1040, Oct 1969. 9 p, 3 fig, 2 tab, 11 ref.

Descriptors: *Groundwater movement, *Saturated flow, *Steady flow, *Excavation, Drainage, Water table, Water levels, Aquifers, Hydraulic conductivity, Aquiclude, Seepage, Inflow.
Identifiers: Drainage to excavations.

Artificial cuts, such as open channels and highway cuts, produce an imbalance in the original groundwater system. The developed drawdowns due to these cuts under the condition of saturated steady flow are studied theoretically by analyzing the seepage through trapezoidal sections of earth entailing the complexity of the free surface. The procedure is then extended to actual cases of ex-

tensive aquifers where such cuts exist. The proposed method is compared with some of the available rigorous mathematical solutions, such as those given by Falkovich, Mikhailov, Meletchenko, Pavlovsky, and Polubarinova-Kochina. The proposed method is simpler in its application and also gives a complete solution for the free surface, the discharge face, the rate of flow, and the hydropotential distribution within the affected region, whereas the rigorous methods are planned essentially for the solution of the free surface only. (Knapp-USGS)
W70-00858

DETERMINING AQUIFER CHARACTERISTICS BY THE TIDAL METHOD,
Department of Energy, Mines and Resources, Ottawa (Ontario). Inland Waters Branch.
P. A. Carr, and G. S. Van Der Kamp.
Water Resources Res, Vol 5, p 1023-1031, Oct 1969. 9 p, 2 fig, 3 tab, 7 ref.

Descriptors: *Transmissivity, *Permeability, *Aquifers, *Tidal effects, Aquiclude, Water storage, Hydraulic conductivity, Artesian wells, Water level fluctuations, Hydrogeology.
Identifiers: Aquifer testing, Tidal efficiency, Prince Edward Island (Canada).

If groundwater levels of a confined aquifer fluctuate with sea tides, individual values of hydraulic conductivity and specific storage can then be determined. Apparent tidal efficiency and time lag are first calculated from the water level data recorded at an observational device situated inland from the sea, taking into account the response characteristics of the observational device. The true tidal efficiency of the aquifer at the seacoast is then determined from the apparent tidal efficiency and used to obtain the specific storage. This and the tidal time lag are utilized to calculate the hydraulic conductivity. The method was tested in Prince Edward Island, Canada, and yielded results compatible with pump test data. This is a simple and inexpensive way to test a confined aquifer in the coastal environment. (Knapp-USGS)
W70-00859

MOVEMENT OF DDT AND NITRATES DURING GROUND-WATER RECHARGE,
Robert S. Kerr Water Research Center, Ada, Okla.
For primary bibliographic entry see Field 05B.
W70-00861

ON THE HYDROGEOLOGY OF THE CENTRAL AND NORTHWESTERN PART OF THE DNIPEPER-DONETS ARTESIAN BASIN (UKRAINIAN),
Kharkov State Univ., (USSR).
For primary bibliographic entry see Field 02K.
W70-00866

A SCHEME OF GEOTHERMAL WATERS OF CENTRAL ASIA (RUSSIAN),
Sredneaziatskii Nauchno-Issledovatelskii Institut Geologii i Mineralnogo Syria, Tashkent (USSR).
B. A. Beder.
Me'ruzeler Doklady, Akad Nauk Azerbaiddzh, SSR, Vol 25, p 34-38, 1969. 1 fig.

Descriptors: *Groundwater, *Aquifers, *Thermal water, Heat flow, Mineral water, Industrial water, Water temperature, Altitude, Reservoir storage, Artesian wells, Geology, Boreholes, Water yield, Mapping.
Identifiers: *USSR, *Central Asia.

A detailed map shows the distribution of 30 artesian and other basins in Central Asia using data compiled in earlier geological and geophysical studies and published deep borehole data. Central Asia may be considered one of the USSR's richest territories in hydrothermal resources. (Gabriel-USGS)
W70-00869

ROLE OF PROGNOSIS OF GROUNDWATER STATE IN PROJECTION OF DAMS (POLISH),
For primary bibliographic entry see Field 08A.
W70-00874

THE WATER-TABLE AQUIFER IN THE EASTERN COASTAL AREA OF BELGIUM,
Rijksuniversitair Centrum te Antwerpen (Belgium); and Ghent Rijksuniversiteit (Belgium).
W. De Breuck, and G. De Moor.
Bull Int Ass Sci Hydrol, Vol 14, No 3, p 137-155, Sept 1969. 19 p, 14 fig, 2 tab, 22 ref.

Descriptors: *Aquifers, *Coastal plains, *Exploration, *Electrical studies, Surveys, Water quality, Conductivity, Resistivity, Water resources development, Water levels, Water chemistry.

Identifiers: *Belgium, Groundwater prospecting.

A resistivity survey using the Wenner arrangement has been conducted in the water-table aquifer in the eastern part of the Coastal Area of Belgium. Bore holes have been drilled to test the geoelectrical data and also to collect water samples. The chemical characteristics and the distribution of different water types explain the hydrochemistry of the water-table aquifer. The fresh-brackish-water boundary as determined by the resistivity survey has been expressed in terms of total dissolved-solids content. (Knapp-USGS)
W70-00986

RECORDS OF SELECTED WELLS AND SPRINGS IN THE RULISON PROJECT AREA, GARFIELD AND MESA COUNTIES, COLORADO,
Geological Survey, Denver, Colo.
For primary bibliographic entry see Field 07C.
W70-00987

GROUNDWATER IN SANTA BARBARA COUNTY, CALIFORNIA, SPRING 1967 TO SPRING 1968,
Geological Survey, Menlo Park, Calif.
For primary bibliographic entry see Field 07C.
W70-00989

ON A SOIL AND GROUND WATER INVESTIGATION WITH THE SHALLOW REFRACTION METHOD AT MO I RANA,
Terrastest A.B., Bromma (Sweden); and Swedish Geotechnical Inst., Stockholm.
For primary bibliographic entry see Field 07B.
W70-00995

AN INEXPENSIVE SHALLOW WATER TABLE PROBE,
Agricultural Research Service, Tucson, Ariz.
Southwest Watershed Research Center.
For primary bibliographic entry see Field 07B.
W70-00996

WATER-RETENTION CHARACTERISTICS OF COARSE ROCK PARTICLES,
Khartoum Univ. (Sudan). Dept. of Geology; and Missouri Univ., Columbia. Dept. of Geology.
For primary bibliographic entry see Field 02G.
W70-00997

LAND SUBSIDENCE DUE TO GROUND-WATER WITHDRAWAL, TULARE-WASCO AREA, CALIFORNIA,
Geological Survey, Washington, D.C.
B. E. Lofgren, and R. L. Klausing.
Geol Surv Prof Pap 437-B, p B1-B101, 1969. 101 p, 69 fig, 15 tab, 54 ref.

Descriptors: *Subsidence, *Compaction, *Water level fluctuations, *Withdrawal, *California. Groundwater, Water yield, Water wells, Geology, Hydrogeology, Instrumentation, Surveys.
Identifiers: Tulare-Wasco area (Calif).

Intensive pumping of groundwater has caused more than 800 sq mi of irrigable land to subside in the Tulare-Wasco area, San Joaquin Valley, Calif. Locally, groundwater levels declined as much as 200 ft between 1905 and 1964, and the maximum subsidence was about 12 ft by 1964. Subsidence was due to the compaction of the water-yielding deposits as the intergranular effective stresses increased. The magnitude and rate of subsidence are directly related to (1) the change in effective stress within the various compacting beds that results from water-level changes and (2) the thickness and compressibility of the compacting deposits. The compressibility of the deposits can be approximated either by testing selected cored samples in the laboratory or by measuring in the field the compaction that results from a given change in effective stress in a subsiding area. The annual rate of subsidence varies greatly in direct response to seasonal pumping. This rate varied from an average of about 136,000 acre-ft per year from 1948 to 1954, to 45,000 acre-ft per year from 1957 to 1959, and to 173,000 acre-ft per year from 1959 to 1962. During the 13 years from 1950 to 1962, the volume of subsidence (1.40 million acre-ft) was roughly 10% of the total groundwater pumpage (13.5 million acre-ft). (Knapp-USGS)
W70-01013

ON THE PRESENT OPTIMUM VARIANT IN HYDROGEOLOGICAL EXPLORATION (GERMAN),

Central Geological Inst., Berlin (East Germany).
For primary bibliographic entry see Field 07C.
W70-01022

TIME VARIANT GROUND WATER FLOW BY RESISTANCE NETWORK ANALOGUES,
Birmingham Univ. (England). Dept. of Civil Engineering.

Robin Herbert.
J Hydrol, Vol 6, No 3, p 237-264, 1968. 28 p, 17 fig, 2 tab, 12 ref.

Descriptors: *Groundwater movement, *Model studies, *Analytical techniques, Water table, Analog models, Steady flow, Storage capacity, Permeability, Dewatering, Drawdown, Hydrologic properties, Flow nets.

Identifiers: *Unconfined flow, Network analogs, Time variant flow, Inertia forces.

A technique is presented for studying time variant unconfined groundwater flow using resistance network analogs. Development of the technique is described first and then it is tested against three analytical solutions to aquifer systems of two dimensional, radial, and three dimensional forms. Testing shows the technique to be accurate and it can be extended to represent any geometric flow net. The method can be used to study three dimensional groundwater flow such as determination of the principles on which to design multi-well dewatering systems. Water-table movement and steady state conditions are shown graphically. Demonstration problems and a comparison of water-table profiles are also graphed. (Lang-USGS)
W70-01039

GENERAL SYSTEMS APPROACH TO GROUND-WATER PROBLEMS,

Arizona, Tucson.
Lucien Duckstein, and Chester C. Kisiel.
Proc Ser No 5, Proc Nat Symp Analysis Water-resour Syst, p 100-115, July 1968. 16 p, 60 ref.

Descriptors: *Groundwater, Reviews, Bibliographies, *Systems analysis, Input-output analysis, Optimum development plans, Aquifers, Mathematical analysis, *Mathematical models, Economics, Dynamic programming, Ecology, Groundwater mining, Numerical analysis, Groundwater recharge, Operations research, Economic justification.

Identifiers: Systems engineering, Problem solving, Hydrologic models, Black box analysis, Well yield, *Groundwater management.

A summary of the state of the art in ground-water systems analysis is presented. Scope of the paper is a combination of concepts from general systems theory, operations research, human factors (economics and social sciences), engineering mathematics, probability and statistics, numerical analysis, and computer sciences woven onto a fabric of classical and modern hydrology. Future strategies for management of the ground-water system must be mixed. Proposed management models require extensive evaluation in a real-world context. Orderly control of withdrawals will be needed to avoid local depletion. Contamination resulting from encroachment of water from the sea or from portions of an aquifer containing saline water must be prevented as well as contamination by indiscriminate deep disposal of waste waters. Ecology as the science of interrelationships must be considered. Economic consequences of ecological factors should be treated as a social cost. Modern developments in systems analysis can sharpen professional judgment and decisions in managing ground-water systems. The formalism and classification outlined are suggested as a complement to the intuitive judgment of professionals having extensive experience in ground-water systems. (USBR)
W70-01123

SUBSURFACE FLOW REGIMES OF A HYDROLOGIC WATERSHED MODEL,

Department of Agriculture, Beltsville, Md.
C. A. Onstad, and D. G. Jamieson.
Second Seepage Symposium, Proceedings, Phoenix, Arizona, Mar 25-27, 1968. Agricultural Research Service, Washington, DC, ARS 41-147, 1969. 10 p, 9 fig, 11 ref.

Descriptors: *Subsurface flow, *Base flow, *Storage coefficient, *Reservoir storage, Watersheds (Basins), Return flow, Hydrology, Groundwater, Groundwater flow, Hydrographs, Groundwater movement, Rainfall-runoff relationships, Seepage, Simulation, Rainfall, Parametric hydrology, Overland flow, Runoff, Infiltration, Outflows.

Identifiers: *Hydrologic models, *Runoff hydrographs.

Historically, separation of baseflow from the total hydrograph was arbitrarily performed under various concepts. All traditional methods of baseflow separation terminate at a nebulous point on the hydrographic recession limb where the flow is assumed to be baseflow. In addition, the assumption is made that the peak baseflow is somehow connected to an identifiable point on the surface runoff hydrograph. The former assumption is subjective; the latter is usually unrealistic. In contrast, the model presented attempts to simulate objectively various subsurface flow regimes. Despite the necessity of inferring the inputs to the various flow regimes, the model is realistic, using only the measured response of each flow regime. The purpose of the model is to separate baseflow from the total hydrograph and to simulate and later synthesize the land phase of the hydrologic system. The model possesses thresholds that make the system nonlinear, but linear reservoir theory is applicable above the thresholds. Few parameters must be derived by iteration since the majority are inserted as measurable quantities. The system is flexible—reservoirs can be added, subtracted, or combined, depending upon the response of the particular watershed. (USBR)
W70-01237

2G. Water in Soils

STEADY FLOW OF WATER THROUGH A TWO-LAYER SOIL,

Iowa State Univ., Ames.

Field 02—WATER CYCLE

Group 2G—Water in Soils

Sam-Arnq Srinita, D. R. Nielsen, and Don Kirkham.
Water Resources Res, Vol 5, No 5, p 1053-1063, Oct 1969. 11 p, 17 fig, 1 tab, 14 ref.

Descriptors: *Soil water movement, *Anisotropy, *Steady flow, Darcy's law, Hydraulic conductivity, Pore pressure, Sorption, Particle size, Clays, Unsaturated flow, Hysteresis.
Identifiers: Layered soils.

A laboratory study of water moving steadily through an isothermal two-layer soil was analyzed by using Darcy's equation for unsaturated flow. Factors considered were thickness and kinds of topsoil, depth of surface water ponding, magnitude of outflow water pressure, and soil water history of the profile. Soil water pressure distributions were measured at 5-cm depth intervals along the vertical columns. The unsaturated hydraulic conductivity was measured for sorption and desorption for each of four soils used as topsoil and subsoil in the two-layer columns. Values of hydraulic conductivity as a function of soil water pressure were used to predict the measured soil water pressure distributions and steady state fluxes. The agreement between predicted and measured profiles is exceptionally close. The necessity of distinguishing between sorption and desorption, of obtaining a uniform soil bulk density distribution within each soil layer, and of ascertaining the hydraulic conductivity as a function of soil water pressure is discussed in relation to the predicted soil water pressure distribution and flux values. (Knapp-USGS)
W70-00840

HYDROSTATICS AND HYDRODYNAMICS IN SWELLING SOILS,
Commonwealth Scientific and Industrial Research Organization, Canberra (Australia). Div. of Plant Industry.
J. R. Philip.
Water Resources Res, Vol 5, No 5, p 1070-1077, Oct 1969. 8 p, 1 fig, 42 ref, append.

Descriptors: *Soil water movement, *Expansive soils, *Expansive clays, Darcy's law, Hydraulic conductivity, Hydrodynamics, Consolidation, Unsteady flow, Steady flow, Unsaturated flow, Infiltration, Diffusion.
Identifiers: Soil-water hydrodynamics, Moisture gradients.

The generalization to swelling soils of the mathematical theory of water movement in unsaturated soils involves the following extensions to the classic analysis: (1) recognition that Darcy's law applies relative to the soil particles, (2) inclusion of the void ratio function in the characterization of the soil, and (3) reconsideration of hydrostatics in swelling media. For swelling soils the total potential includes an additional component, the overburden potential, evaluation of which leads to the condition for equilibrium in the vertical, which is a first order linear differential equation with singular coefficients. Three types of equilibrium profile follow: hydric profiles with moisture gradient less than 0, pycnotic profiles with gradients of 0, and xeric profiles with gradients greater than 0. Other phenomena in swelling soils treated include steady vertical flows and unsteady horizontal and vertical flows. Classic concepts of groundwater hydrology, tacitly based on the behavior of nonswelling media, fail completely for swelling soils. The approach also provides a theory of consolidation which includes the influences of (1) soil particle movement, (2) unsaturation, and (3) self-weight. (Knapp-USGS)
W70-00841

A NUMERIC METHOD FOR ESTIMATING INFILTRATION, REDISTRIBUTION, DRAINAGE, AND EVAPORATION OF WATER FROM SOIL,
Utah State Univ., Logan; Illinois Univ., Urbana; and Colorado State Univ., Fort Collins.
R. J. Hanks, A. Klute, and E. Bresler.
Water Resources Res, Vol 5, No 5, p 1064-1069, Oct 1969. 6 p, 7 fig, 4 ref.

Descriptors: *Soil water movement, *Infiltration, *Percolation, *Drainage, *Evaporation, Hysteresis, Unsaturated flow, Numerical analysis, Digital computers, Profiles, Hydraulic conductivity.
Identifiers: Soil water redistribution.

A general numeric method is described for estimating one-dimensional infiltration, redistribution, evaporation, and drainage of water from soil. The type of flow is determined by the water flux at the surface of soil or the bottom boundary. The method provides for hysteresis in the water content - pressure head relation. Comparison with measurement made on soil columns for infiltration, redistribution, and evaporation were made. Good agreement was obtained between measured and computed values. (Knapp-USGS)
W70-00862

SOIL MOVEMENT ON IRREGULAR SLOPES,
Agricultural Research Service, Morris, Minn. Soil and Water Conservation Research Div.
For primary bibliographic entry see Field 02J.
W70-00864

TEMPORAL, HORIZONTAL AND VERTICAL VARIABILITY OF WATER CHEMISTRY IN UNSATURATED ZONE OF FINE-GRAINED SOILS,
Idaho Univ., Moscow. Water Resources Research Inst.
For primary bibliographic entry see Field 05B.
W70-00911

WATER-RETENTION CHARACTERISTICS OF COARSE ROCK PARTICLES,
Khartoum Univ. (Sudan). Dept. of Geology; and Missouri Univ., Columbia. Dept. of Geology.
Ismail M. El Boushi, and Stanley N. Davis.
J Hydrol, Vol 8, No 4, p 431-441, Aug 1969. 11 p, 7 fig, 1 tab, 4 ref.

Descriptors: *Water storage, *Infiltration, *Recharge, *Gravels, *Specific retention, Percolation, Unsaturated flow, Rainfall-runoff relationships, Surface-groundwater relationships, Wetting, Wettability, Surfaces, Saturation.
Identifiers: Rock rubble.

Water is retained on large particles of non-porous rock as a film of water about 0.1 mm thick on rock surfaces, as 0.006 to 0.180 ml droplets held at contact points between adjacent particles, and as small puddles of water on the upper surfaces of the rock. Water retained at contact points accounts for most of the water stored within aggregates of particles with diameters smaller than 30 mm. Whereas with diameters larger than 100 mm, water retained on the rock surfaces, particularly water puddled on top of the rock, accounts for most of the water. Infiltrating water will not wet all the rock surfaces. More than 50% of the surfaces may be dry at depth. The total amount of rainfall needed to initiate groundwater recharge in many areas having coarse rock particles at the surface is probably less than 1.0 cm. (Knapp-USGS)
W70-00997

2H. Lakes

TOTAL ALBEDO OF GREAT LAKES ICE,
United States Lake Survey, Detroit, Mich.
For primary bibliographic entry see Field 02C.
W70-00851

WATER TEMPERATURE DURING THE MELTING OF LAKE ICE,
National Research Council of Canada, Ottawa (Ontario).
G. P. Williams.
Water Resources Res, Vol 5, No 5, p 1134-1138, Oct 1969. 5 p, 4 fig, 2 tab, 8 ref.

Descriptors: *Water temperature, *Lake ice, *Melting, Climates, Albedo, Solar radiation, Energy budget.

Identifiers: *Canada, Ontario, White Lake, Ice thickness.

Water temperature and ice thickness were measured during the ice melt period at Bennett Bay, White Lake, Ontario. Water temperatures were as high as 7.5 deg C under the melting ice cover. The heat needed to warm the water under the ice and to melt ice at the ice-water interface was calculated for different periods and compared with the heat available from solar radiation that penetrated the ice cover. It was concluded from these calculations that solar radiation penetrating the ice caused the relatively high water temperatures observed under the melting ice. (Knapp-USGS)
W70-00852

NEW THERMAL INVESTIGATION OF LAKES TRAUHSEE AND FUSCHLSEE (IN GERMAN),
O. Eckel.
Verh Internat Verein, Limnol, XIV, Stuttgart, p 70-78, July 1961.

Descriptors: *Lakes, *Thermal properties, *Stratification, Epilimnion, Hypolimnion, Thermocline, Temperature, Wind velocity, Meteorological data.

Investigations of thermal changes in various depths of two lakes in Austria proved the dependence of water temperature fluctuation in all layers on meteorological conditions. It was stated that the mutual dependence between the motion of water, wind, and temperature distribution exists. It was also stated that the water in deeper layers is always in motion even if the water surface of a lake is quiescent. The investigated temperature fluctuations were either periodical or non-periodical. The former had 24-hour periods and the latter were caused by wind effects. Periodical wind formation caused an occurrence of free currents in both lakes. The total movement of water particles in all layers of a lake were found to be the vector summation of wind effects and inert waves. The influence of warm storm air on temperature change was most remarkable in the deeper layers (differences up to 2C in a 50 m deep layer in comparison with 0.3C in the surface layer). (Novotny-Vanderbilt)
W70-00886

A STOCHASTIC APPROACH TO THE DEVELOPMENT OF A REGULATION PLAN FOR THE GREAT LAKES,
Department of Energy, Mines and Resources, Ottawa (Ontario). Inland Waters Branch; and McGill Univ., Montreal (Quebec).
R. H. Clark, and G. S. Cavadias.
Proc, Int Hydrol Symp, Vol 1, Colo State Univ, p 430-442, Sept 1967. 13 p, 8 fig, 4 tab, 4 ref.

Descriptors: *Stochastic processes, *Great Lakes, *Simulation analysis, *Optimization, *Water resources development, Navigation, Hydroelectric power, Operating costs, Water control, Water levels, Synthetic hydrology.
Identifiers: Multivariate model.

A progress report was given on research results of a joint United States-Canadian regulation study for the Great Lakes. The objective of the study was to establish a regimen of lake levels and outflows which would maximize the benefits and minimize the detriments equitably among all interests. Navigation was best served by high lake levels, hydro-power generation by maintenance of minimum flows as large as feasible, while shore property interests benefited most by reductions in the extremes of both high and low lake levels. Computer simulation techniques were used both for generating and testing artificial flow sequences and for determining the consequences of various operating plans. The multivariate model proposed by Fiering was used in the simulation and the sequences generated were subjected to several tests

Water in Plants—Group 21

in order to verify whether properties of the recorded supplies were conserved. The regulation plan was considered as a sequence of decisions under uncertainty with the testing record generated by a stochastic process. (Thiuri-Cornell)
W70-00902

A LIMNOLOGICAL COMPARISON OF TWO SMALL IDAHO RESERVOIRS,
Idaho Univ., Moscow. Dept. of Biological Sciences.
Gary W. Miller, and Fred W. Rabe.
Hydrobiologia, Vol 33, No 3-4, p 523-544, July 22, 1969. 22 p, 12 fig, 4 tab, 38 ref.

Descriptors: *Limnology, *Idaho, *Reservoirs, Sampling, Physicochemical properties, Zooplankton, Nannoplankton, Productivity, Mapping, Analytical techniques, Water level fluctuations, Water temperature, Heat budget, Organic matter, Hydrogen, Carbon dioxide, Seasonal.
Identifiers: Reservoir limnology.

Physicochemical characteristics of the water, zooplankton, and nannoplankton concentrations of two Idaho reservoirs were investigated by using chemical analysis, electronic thermometers, a secchi disk, and C-14 isotope methods. No well-defined thermocline can be identified in Deep Creek or Crowthers Reservoir. Annual heat budget is estimated to be about 15,000 cal/sq cm for both reservoirs, with low dissolved oxygen concentrations on the bottom during the summer months. Both reservoirs are alkaline with pH ranging from 7.5 to 8.9. The mean summer primary production rates of nannoplankton were 9.9 mg cu m/hr and 6.7 mg cu m/hr for the Crowthers and for the Deep Creek Reservoirs, respectively. The biomass of detrital heterotrophs was highest in the Crowthers Reservoir. (Gabriel-USGS)
W70-01005

DIAGENETIC CHANGES IN INTERSTITIAL WATERS OF HOLOCENE LAKE CONSTANCE SEDIMENTS,
Heidelberg Univ. (West Germany). Sediment Lab. German Muller.
Nature, Vol 224, p 258-259, Oct 1969. 2 p, 2 fig, 5 ref.

Descriptors: *Water chemistry, *Diagenesis, *Lakes, Sedimentation, Fresh water, Chemical reactions, Mineralogy, Clays, Organic matter, Biodegradation, Sedimentation rates.

Identifiers: *Lake Constance, *Switzerland.

Water samples from cones taken from the bottom of Lake Constance, Switzerland were analyzed. In the fresh water sediments of the lake the pore water is changed considerably after entrainment so that it is no longer similar to the lake water. The sulfate content is entirely removed, chlorine is depleted, and Na, K, Mg, silica, nitrogen, phosphorus, and bicarbonate are considerably increased by reactions between water and minerals and by organic decay. (Knapp-USGS)
W70-01009

STRONTIUM-90 CONCENTRATION FACTORS OF LAKE PLANKTON, MACROPHYTES, AND SUBSTRATES,
Akademiya Nauk URSR. Inst. of Biology of the Southern Seas.
For primary bibliographic entry see Field 05C.
W70-01010

SEASONAL CHARACTERISTICS OF TWO SALINE LAKES IN WASHINGTON,
Washington Univ., Seattle. Dept. of Zoology.
G. C. Anderson.
Limnology and Oceanography, Vol 3, p 51-68, 1958. 6 fig, 4 tab, 21 ref.

Descriptors: *Saline lakes, *Washington, *Seasonal, *Limnology, *Arid lands, Phytoplankton, Distribution, Sampling, Temperature, Oxygen,

Hydrogen ion concentration, Alkalinity, Phosphates, Chlorophyll, Shallow water, Nutrients, Diatoms, Depth, Biota, Meromixis, Zooplankton, Calcium, Magnesium, Sodium, Potassium, Carbonates, Sulfates, Bicarbonates, Chlorides, Nitrates, Outlets, Evaporation, Runoff, Hydrogen sulfide, Stratification, Diatoms, Spores, Rotifers, Cyanophyta, Chrysophyta, Chlorophyta.

Identifiers: Morphometric conditions, Transparency, Lake Lenore (Wash), Amphora, Chaetoceros elmorei, Soap Lake (Wash), Monimolimnion, Dicthichis stricta, Mixolimnion, Scirpus nevadensis, Juncus bifurcus, Asterionella formosa, Cyclotella, Eunotia, Fragilaria crotonensis, Melosira distans, Navicula, Nitzschia, Tabellaria flocculosa, Gloeocystis, Oscillatoria, Spirulina major, Ceratoneis, Cladocera, Lake volume.

Limnology of two saline lakes in Washington was studied in relation to physical and chemical conditions influencing growth and distribution of phytoplankton. The lakes were sampled at frequent intervals for more than a year, between 1950 and 1951. Morphometric conditions were determined, and routine sampling included measurements of temperature, transparency, oxygen, pH, alkalinity, phosphate, chlorophyll, and quantitative samples of phytoplankton. Lake Lenore, the less saline of the two (total dissolved solids, 14 grams/liter), is shallow and was unstratified during the investigation. Dissolved nutrients were high and varied erratically during summer. The taxonomically simple phytoplankton population is comprised mainly of two species of diatoms—Amphora sp, which forms the spring bloom, and Chaetoceros elmorei, which constitutes the late summer bloom. Soap Lake is relatively deep, meromictic, and saline (total dissolved solids, 35 grams/liter). Temperature conditions are dichothermic, and nutrient content high, especially in the monimolimnion. A winter maximum and summer minimum in the phytoplankton population was observed and a change in the biota during dilution of the lake in recent years is described. There are indications that phytoplankton is grazed by zooplankton in both lakes. (Jones-Wisconsin)
W70-01076

SOME LIMNOLOGICAL FEATURES OF A SHALLOW SALINE MEROMICTIC LAKE,
Washington Univ., Seattle. Dept. of Zoology.
G. C. Anderson.
Limnology and Oceanography, Vol 3, p 259-270, 1958. 6 fig, 4 tab, 16 ref.

Descriptors: *Limnology, *Arid lands, *Saline lakes, *Meromixis, *Shallowwater, Washington, Magnesium compounds, Temperature, Chara, Cyanophyta, Sulfur bacteria, Zooplankton, Gypsum, Hydrogen ion concentration, Oxygen, Dissolved solids, Light penetration, Depth, Volume, Runoff, Seasonal, Hydrogen sulfide, Solar radiation, Evaporation, Heating, Light intensity, Chlorides, Bicarbonates, Sodium, Rotifers, Copepods, Aerobic conditions, Thermal stratification, Lake morphology.

Identifiers: Kruger Mountain (Wash), Hot Lake (Wash), Oroville (Wash), Distichlis spicata, Artemia salina, Transparency, Morphometry, Lake area, Monimolimnion, Vertical, Mixolimnion, Chemocline, Chlorobium, Salt gradient, Bottom waters, Heat gain, Heat loss, Mineral analyses, Plectonema nostocorum, Oscillatoria chlorina, Anacystis thermalis, Gomphosphaeria aponina, Brachionus angularis, Keratella quadrata, Ostracod, Branchinecta, Epsom salt.

Seasonal variations of some physical, chemical, and biological features were studied from December 1954 to October 1956 in Hot Lake, a shallow saline body of water occupying a former epsom salt excavation in north central Washington. Since it has neither an inlet nor outlet, evaporation is important. The lake is meromictic, and, during the period of study, had an average salt gradient of approximately 100 grams per liter (g/l) at the surface to 400 g/l at the bottom, the major salt being magnesium sulfate. The mixolimnion was thin enough that

the monimolimnion was heated directly by the sun, with resulting temperatures in excess of 50 deg C recorded in the monimolimnion during summer. The mixolimnion was transparent; the monimolimnion, opaque. Much of this heat was retained during the winter. The calculated value of heat gain in the monimolimnion agreed well with observed values. The flora consisted mainly of Chara, a bottom mat of blue-green algae, and a dense population of green sulfur bacteria in the upper part of the monimolimnion. Artemia salina was the dominant zooplankton, and some features of its life history, as affected by the unusual thermal properties of the lake, are described. (Jones-Wisconsin)
W70-01077

ABOUT THE QUESTION OF VERTICAL MIXING OF WASTE WATERS IN CLOSED RESERVOIRS (In Russian),
For primary bibliographic entry see Field 05B.
W70-01078

LIMNOLOGICAL EFFECTS OF ORGANIC EXTRACTS OF LITTER IN A SOUTHWESTERN IMPOUNDMENT,
Arizona Univ., Tucson; and Arizona Cooperative Fishery Unit, Tucson.
William J. McConnell.

Limnology and Oceanography, Vol 13, No 2, p 343-349, Apr 1968. 1 fig, 4 tab, 16 ref.

Descriptors: *Limnology, *Organic matter, *Impoundments, *Arizona, Biomass, Carbohydrate, Epilimnion, Hypolimnion, Watershed, Ecology, Lakes, Secondary productivity, Pass, Food chains, Microorganisms, Snails, Zooplankton, Fish, Harvesting.

Identifiers: Phenolics, Xenopus laevis, Micropterus salmoides, Litter (Forest), Pena Blanca Lake (Ariz), Quercus emoryi, Quercus oblongifolia, Ecological efficiencies, Production (Fish), Harvest (Fish).

Torrential rains in July, following dry winters and springs, cause considerable quantities of litter from the watershed to be deposited into impoundments in southeastern Arizona, with subsequent limnological consequences. Author describes limnological effects of oak litter extracts, the dominant evergreen, in Pena Blanca Lake which received 750 grams/square meter of litter during summer of 1959. Cold-water extracts of oak litter reveal that carbohydrates and phenolics were the major soluble compounds. Glucose was the predominant sugar. Presence of an unidentified compound was suggested as postulated to be an organic acid. Growth rates of larval Xenopus laevis were significantly increased by addition of oak leaves to the environment. Estimated production during 1959 of trophically similar animals attributed to litter import was 2.35 grams biomass/square meter. (Daniel-Wisconsin)
W70-01080

21. Water in Plants

ESTIMATES OF PERiphyton MASS AND STREAM BOTTOM AREA USING PHOSPHOROUS-32,
Oak Ridge National Lab., Tenn. Radiation Ecology Section.

D. J. Nelson, N. R. Kevern, J. L. Wilhm, and N. A. Griffith.

Water Research, Vol 3, No 5, p 367-373, May 1969. 7 p, 1 tab, 15 ref. Res sponsored by U.S. Atomic Energy Comm under contract with Union Carbide Corp.

Descriptors: *Periphyton, *Phosphorous radioisotopes, *Biomass, *Analytical techniques, Channel morphology, Sediments, Sorption, Radioactivity techniques, Biota, Hydraulic properties, Roughness (Hydraulic).

Identifiers: *Periphyton mass measurement, Bottom surface (Streams).

Field 02—WATER CYCLE

Group 21—Water in Plants

A rapid method is given for determining the biomass of periphyton and the bottom surface area of a small rocky stream by using P-32. About 75% of the introduced P-32 was retained within 100 m study area. Periphyton on artificial substrate sorbed 254 times more P-32 than sediments and 48 times more than leaves. The absorption of P-32 was also measured for natural substrata. Uptake appeared to be a surface phenomenon. Total standing crop in the test area was calculated to be 1.5 kg. The bottom area was found to be 560 sq m, about four times larger than estimated by usual surface measurements. In view of the irregular topography of the stream bottom, the value obtained from uptake of P-32 requires better estimation of the total bottom area than available from surface measurements. The technique is adaptable to shallow streams where periphyton is a major component of the biota. The technique can be used for measurement of surface areas for uneven stream channels and hydraulic parameters such as bed roughness. (Carstea-USGS)
W70-00846

NET RADIATION IN A RIPARIAN MESQUITE COMMUNITY,
Agricultural Research Service, Tucson, Ariz.
Southwest Watershed Research Center.
J. M. Tromble, and J. R. Simanton.
Water Resources Res, Vol 5, No 5, p 1139-1141,
Oct 1969. 3 p, 1 fig, 6 ref.

Descriptors: *Solar radiation, *Mesquite, *Arid lands, Energy budget, Energy, Albedo, Meteorology.
Identifiers: Net radiation.

Net radiation patterns for a riparian mesquite community are similar to net radiation patterns obtained for a humid forest. The net radiation peak of the open area was 61% of the net radiation peak above the canopy. The net radiation within a mesquite canopy peaked 9% higher but had a lower daily total value than the radiation above the canopy. The differences in net radiation peaks were attributed to differences in the canopy geometry, solar position, and surface reflectance, whereas differences in daily net radiation were attributed to differences in surface reflectance characteristics. (Knapp-USGS)
W70-00853

THE DEVELOPMENT AND DISTRIBUTION OF PLANKTON IN THE NORTHERN PART OF THE WHITE NILE,
Khartoum Univ. (Sudan). Dept. of Zoology.
Y. B. Abu Gideiri.

Hydrobiologia, Vol 33, No 3-4, p 369-378, July 22, 1969. 10 p, 7 fig, 7 ref.

Descriptors: *Plankton, *Rivers, *Plant growth, *Water quality, Plant populations, Sampling, Electrical conductance, Biology, Water chemistry, Oxygen, Ions, Chlorides, Sulfates, Crustaceans, Seasonal, Organic matter, Temperature, Alkalinity. Identifiers: *Sudan, White Nile.

The plankton population of the White Nile was investigated by analyzing samples from three stations located along the 45 km course of the river and using the results of earlier publications. The study shows the presence of two yearly plankton growth peaks whose development and distribution are correlated with environmental conditions such as transparency, temperature, dissolved gases, nutrients, pH, alkalinity, conductivity, etc. Rotifers outnumber crustaceans at the Morgan sampling station and are at equilibrium at Jebel Aulia. The presence of *Tropodiaptomus processifer*, *T. Kraepelini*, *T. Orientalis*, *Brachionus caudatus*, *Anabaenopsis circularis*, and *Closterium bibleinii* at the Morgan sampling station indicates the effect of the Blue Nile waters on the White Nile. (Gabriel-USGS)
W70-01007

EFFECTS OF EXTERNAL SALT CONCENTRATIONS ON WATER RELATIONS IN PLANTS: SIGNIFICANCE OF EXTERNAL WATER-POTENTIAL AND SALT-TRANSPORT KINETICS ON RATE OF CELL EXPANSION, California Univ., Riverside.

J. J. Oertli.
Soil Science, Vol 105, No 4, 1968, p 216-222. 7 p, 2 fig, 18 ref.

Descriptors: *Salinity, *Saline soils, *Soil-water-plant relationships, *Plant physiology, *Plant growth, Osmotic pressure, Turgidity, Xylem, Kinetics, Cytological studies.

Identifiers: *Turgor pressure, Salt transport.

Soil salinity generally results in a reduction of plant growth. This report theoretically investigates the effect of external salt concentration and of the solute transport on cell elongation. When internal hydrostatic pressure exceeds external pressures, plant cells elongate. If water transport into the cell occurs in response to salt addition to the vacuole, the rate-limiting factor is probably the salt, and not the water transport. Solute requirement is a function of total water potential at the root surface. Salt transport rates depend upon external concentration and obey kinetics of decreasing efficiency. The cell elongation rate depends upon external concentration; the time for unit elongation decreases, passes through a minimum and subsequently increases in the range of saline conditions. Experimental support of the conclusions will be presented in a subsequent paper. (Crouse-Arizona)
W70-01214

2J. Erosion and Sedimentation

ANNOTATED BIBLIOGRAPHY ON HYDROLOGY AND SEDIMENTATION, 1963-65, UNITED STATES AND CANADA.

Engineering-Science, Inc., Los Altos, Calif.

For sale by the Superintendent of Documents, US Government Printing Office, Wash, DC 20402, price \$4.50. Joint Hydrol-Sedimentation Bull No 9, Inter-Agency Comm on Water Resources, June 1969. 527 p.

Descriptors: *Bibliographies, *Water resources, *Hydrology, *Sedimentation, Abstracts, Documentation, Sediment transport, Groundwater movement, Hydrogeology, Hydraulics, Open channel flow, Water law, Water management (Applied).

Identifiers: Hydrology and sedimentation bibliography.

The Hydrology and Sedimentation Committees, Water Resources Council, have sponsored this Bibliography as a guide to literature on hydrology and sedimentation for the use of Government agencies and the public. Every effort has been made to cover all such literature published in the United States and Canada during 1963-1965. The index of the bibliography covers both place and subject. In the United States and Canada, the smallest geographical subdivisions used are states and provinces. Elsewhere, geographical subdivision is by country. For papers applying to areas larger than the smallest subdivision, entries are listed under major river basins in the United States and by continents for the rest of the world. In general, listings in the index are primary. (Knapp-USGS)
W70-00837

MODIFIED RUBEY'S LAW ACCURATELY PREDICTS SEDIMENT SETTLING VELOCITIES,

Texas Univ., Austin.

Richard L. Watson.

Water Resources Res, Vol 5, No 5, p 1147-1150, Oct 1969. 4 p, 2 fig, 1 tab, 3 ref.

Descriptors: *Settling velocity, *Equations, *Particle size, *Particle shape, *Analytical techniques,

Viscosity, Reynolds number, Deposition (Sediments), Suspension.

Identifiers: Settling tubes, Sediment analyzers.

Modification of viscous drag and the pressure drag terms in Rubey's theoretic equation for settling velocity of sand grains with two empirically determined constants results in a formula which predicts accurately the settling velocity of groups of sand grains measured with the Woods Hole rapid sediment analyzer. This modified formula can now be used for calculation of particle size with fall time data from the sediment analyzer. The advantage of this method rather than the use of empirical data for particle size determination is that the determination can be made regardless of the water temperature in the settling tube, the viscosity of the fluid in the tube, or the relative densities of the fluid and the particles, as long as these values are known. (Knapp-USGS)
W70-00855

USE OF MEMBRANE FILTERS IN GRAVIMETRIC ANALYSES OF PARTICULATE MATTER IN NATURAL WATERS,

Dartmouth Coll., Hanover, N. H., and Yale Univ., New Haven, Conn.

For primary bibliographic entry see Field 07B.
W70-00857

SOIL MOVEMENT ON IRREGULAR SLOPES,

Agricultural Research Service, Morris, Minn. Soil and Water Conservation Research Div.

Robert A. Young, and Calvin K. Mutchler.
Water Resources Res, Vol 5, No 5, p 1084-1089, Oct 1969. 6 p, 2 fig, 4 tab, 11 ref.

Descriptors: *Soil erosion, *Model studies, *Simulated rainfall, Gully erosion, Rill erosion, Sheet erosion, Runoff, Slopes, Topography, Soil conservation, Rainfall intensity, Tracers, Dye releases.

Identifiers: Soil erosion test plots, Soil movement tracers.

Soil loss and runoff were measured from concave, uniform, and convex slopes subjected to simulated rainfall. Fluorescent glass particles and microrelief measurements were used to determine soil movement patterns in the slopes. For slopes of equal average steepness, a concave shape greatly reduced the total sediment loss in comparison with that from either a uniform or convex slope. Average slope steepness was not a good indicator of soil delivery past a given point except for a uniform slope. In general, soil losses from irregular slopes depend on the steepness of a short section of that slope immediately above the point of measurement. Soil movement off the plots was primarily transport by raindrop splash to a rill system and then transport down the slope by runoff in the rill system. A breakdown of the rill system occurred on the bottom of the concave slopes because of decreasing local steepness, resulting in sheet flow and sediment deposition. (Knapp-USGS)
W70-00864

RELATIVE DENSITY EFFECTS ON INCIPIENT BED MOVEMENT,

Minnesota Univ., Minneapolis.

Bruce D. Ward.

Water Resources Res, Vol 5, No 5, p 1090-1096, Oct 1969. 7 p, 4 fig, 2 tab, 10 ref.

Descriptors: *Bed load, *Sediment transport, Tractive forces, Shear stress, Shear drag, Mathematical studies, Density, Model studies, Hydraulic models, Turbulence, Turbidity.

Identifiers: Bed load movement, Stress analysis.

The Shields entrainment function, extrapolated from bed load movement to predict the threshold of particle motion, appears deficient in analyzing incipient shear data for fluid-sediment combinations encompassing a wide range of relative densities. Equations describing incipient dynamic equilibrium, solved semiempirically, indicate addi-

Erosion and Sedimentation—Group 2J

tional density considerations that must be included in an attempt to correlate initial movement for all possible sedimentation density ratios. This and other experimental investigations also indicate any entrainment function to be independent on the state of the bed and corresponding turbulence. Other factors which might be influential on the threshold of particle movement are mentioned. (Knapp-USGS)
W70-00865

FLUORESCENT SAND AS A TRACER OF FLUVIAL SEDIMENT,

Geological Survey, Menlo Park, Calif.
Vance C. Kennedy, and Dorothy L. Kourba.
Geol Surv Open-file Rep, 1968. 53 p, 14 fig, 4 tab,
21 ref.

Descriptors: *Sediment transport, *Tracers, *Fluorescence, *On-site tests, Sedimentary rocks, Rivers, Sands, Sampling, Petrology, Mapping, Discharge measurement, Mathematical studies, Suspended load, Currents (Water), Velocity, Streamflow.
Identifiers: *Fluvial sediments, Fluorescent sand tracer.

A description is given of on-site tests to evaluate use of the fluorescent sand method as a means of measuring sediment discharge in a gravel-bed stream. Stream sand coated with fluorescent paint was added at a constant known rate to Clear Creek at Golden, Colorado, during a 28-hour period and the concentration of fluorescent grains was recorded at a site 810 meters downstream from the point of introduction. First-arrival time of fluorescent sand was correlated with the square of grain diameter for particles in the range of 0.15-0.86 mm. Complete lateral mixing of fluorescent sand was not achieved within the study reach, but steady-state conditions apparently were achieved for the finer particles. The lateral mixing of coarser grains was found to be much better than that for finer grains. Sediment discharge computed from the tracer dilution method was about 30% greater than the suspended-sediment discharge computed for suspended samples of the 0.15-0.18 mm range and about 200% greater for the 0.38-0.52 mm range. (Gabriel-USGS)
W70-00867

GLACIAL HISTORY AND MORPHOLOGY OF WEST SWEDEN (SWEDISH),

Lund Univ. (Sweden). Geographical Inst.
For primary bibliographic entry see Field 02C.

W70-00998

FREQUENCY DISTRIBUTIONS OF STREAM LINK LENGTHS,

Princeton Univ., N.J. Dept. of Statistics.

W. R. James, and W. C. Krumbein.

Office of Naval Research Contract Nonr-1228 (36), ONR Task No 389-150. J Geol, Vol 77, No 5, p 544-565, Sept 1969. 22 p, 9 fig, 6 tab, 14 ref.

Descriptors: *Topography, *Drainage patterns (Geologic), *Streams, *Statistical models, Drainage density, Tributaries, Markov processes, Stochastic processes, Networks, Regional analysis.
Identifiers: *Drainage basin morphology, Drainage net topology.

Theories of drainage basin topology are reviewed and compared, and a new theoretical analysis is offered. Analysis of interior links in a magnitude 1311 basin shows that the probability of successive tributaries entering main channels from the same side is only about two-thirds the probability of opposite-side entry. These higher-order structures in the data (the spatial arrangement of successive tributaries) display a first-order Markovian property in sequences of link type. These structures are examined in their substantive context, and a composite gamma-like population density for interior link lengths is developed theoretically. This density contains the higher-order structures and agrees, at

least approximately, with observed relations in main channels of magnitude 10 or greater. (Knapp-USGS)
W70-01006

DIAGENETIC CHANGES IN INTERSTITIAL WATERS OF HOLOCENE LAKE CONSTANCE SEDIMENTS,

Heidelberg Univ. (West Germany). Sediment Lab.
For primary bibliographic entry see Field 02H.

W70-01009

THE LAKE MISSOULA FLOODS AND THE CHANNELED SCABLAND,

Chicago Univ., Ill. Dept. of the Geophysical Sciences.

J. Harlen Bretz.

J Geol, Vol 77, No 5, p 505-543, Sept 1969. 39 p,

10 fig, 2 plate, 2 tab, 53 ref.

Descriptors: *Geomorphology, *Topography, *Floods, *Pleistocene epoch, *Columbia River, Oregon, Washington, Montana, Idaho, Erosion, Historic flood, Deposition (Sediments), Discharge (Water), Sedimentary structures, Sedimentation, Channel morphology.
Identifiers: Channeled Scablands.

This paper reviews the outstanding evidence for repeated catastrophic outbursts of Montana's glacially dammed Lake Missoula. Flooding consequently overwhelmed in many places the preglacial divide along the northern margin of the Columbia Plateau in Washington. The plateau's preglacial drainage pattern was remade into an anastomosing complex of floodwater channels (Channeled Scabland) locally eroded hundreds of feet into underlying basalt. These flood-born rivers converged into the Columbia Valley at least as far as Portland, Oregon, depositing a huge delta at Portland. Evidence that the major scabland rivers and the flooded Columbia were hundreds of feet deep exists in: gravel and boulder bars more than 100 ft high in mid-channels; subfluvial cataract cliffs, alcoves, and plunge pools hundreds of feet in vertical dimension; back-flooded silts high on slopes of preglacial valleys tributary to the scabland complex; and the delta at Portland. Climatic oscillations of the Cordilleran ice sheet produced a succession of Lake Missoulas. The Montana glacial record has been correlated with recurrent scabland floods by soil profiles and a glacial and loessial stratigraphy, and some events have been approximately dated by volcanic ash layers, peat deposits, and an archaeological site. (Knapp-USGS)
W70-01012

FORMATION OF HYDROXY-AL AND -FE INTERLAYERS IN MONTMORILLONITE AND VERMICULITE: INFLUENCE OF PARTICLE SIZE AND TEMPERATURE,

Geological Survey, Washington, D.C.

For primary bibliographic entry see Field 02K.

W70-01014

THE VOLUME AND CHARACTER OF SILTING-SEDIMENTATION OF THE SIONI RESERVOIR (RUSSIAN),

G. S. Metrebeli.

Soobshchenie Akademii Nauk Gruzinsskoi SSR, Vol 52, No 3, p 689-694, Dec 1968. 2 fig, 1 tab, 4 ref.

Descriptors: *Reservoir silting, *Water storage, *Silting, Rivers, Discharge (Water), Runoff, Water level fluctuations, Sedimentation rates, Geology, Organic matter, Solid wastes, Mathematical studies, Forecasting, Landslides.
Identifiers: *USSR, Sioni reservoir.

Silting of the Sioni reservoir, USSR, was investigated on the basis of geological and hydrological data recorded in 1963 to 1967. The sedimentary layer thicknesses vary from zero to 1.2 m. During 4 years of the existence of the reservoir the Iory

River brought in 960,000 cu m of solid material in addition to 130,000 cu m brought in by minor streams. In general the silting can be considered as of minor importance because the bottom sediments can be easily transferred into the lower reaches of the Iory River by using suitable mechanical devices. (Gabriel-USGS)
W70-01019

THE ANALYSIS AND CLASSIFICATION OF SLOPE PROFILE FORMS,

Sheffield Univ. (England). Dept. of Geography.

R. A. G. Savigear.

Evolution Des Versants, Proc Symp de Geomorphologie, Liege-Louvain, Belgium, June 8-16, 1966, Vol 40, p 271-272, 1967. 2 p, 5 fig, 3 ref.

Descriptors: *Geomorphology, *Slopes, *Classification, *Profiles, *Terrain analysis, Mapping, Erosion, Surveys, Analytical techniques, Land forming, Topography, Sedimentation.
Identifiers: England, Slope profiles.

A classification of slope profiles is developed on the basis of data recorded at the seaward slopes in Cornwall, Southwestern England. The classification is of morphological character which essentially differs from earlier classifications of geomorphogenetic character. The techniques are intended to provide methods by which the recognition of the form elements of a profile may be investigated and objectively defined. The study contains the following topics: classification problems related to the selection and survey of profiles; methods of analysis and classification; measured length profile; the intercept profile; the unit profile; a classification of unit relationship; and a classification of unit groups. (Gabriel-USGS)
W70-01040

THE DYNAMICS OF QUATERNARY SLOPE EVOLUTION AND ITS GEOMORPHOLOGICAL REPRESENTATION,

M. Peci.

Evolution Des Versants, Proc Symp de Geomorphologie, Liege-Louvain, Belgium, June 8-16, 1966, Vol 40, p 187-199, 1967. 13 p, 6 fig, 1 tab, 2 ref.

Descriptors: *Dynamics, *Slopes, *Aeolian soils, *Erosion, *Quaternary period, Glaciation, Climates, Sedimentation, Freezing, Topography, Geology, Clays, Loess, Sands, Gravels, Solifluction, Mass wasting, Deposition (Sediments).
Identifiers: *Hungary, Danube basin, Slope evolution.

The stratigraphy of thick layers of Pleistocene loess of the Central Danube basin was investigated to determine the processes of formation of Quaternary slopes. The sedimentary layers of the hillslopes are well to poorly stratified and consist of aeolian loess, sands, and fossil-bearing soils. Subaerial stream erosion alternated with the processes of deposition; however, in many places the changes in the slope curvatures completely obliterated the high intensity processes of earlier accumulation and deposition. Cryogenic processes acted in different combinations, with different intensity and efficiency on different parts of the slopes, in function of the lithology, slope angle, exposure and, in general, of local biogeographical, morphological and microclimatic conditions. (Gabriel-USGS)
W70-01041

PLEISTOCENE ACTIVITY AND HOLOCENE STABILITY OF HILLSLOPES, WITH EXAMPLES FROM SCANDINAVIA AND PENNSYLVANIA,

Anders Rapp.

Evolution Des Versants, Proc Symp de Geomorphologie, Liege-Louvain, Belgium, June 8-16, 1966, Vol 40, p 229-244, 1967. 16 p, 5 fig, 1 tab, 14 ref.

Field 02—WATER CYCLE

Group 2J—Erosion and Sedimentation

Descriptors: *Erosion, *Slopes, *Slope stability, *Solifluction, *Pleistocene epoch, *Pennsylvania, Quaternary period, Glaciation, Geology, Altitude, Climates, Soils, Humidity, Mapping, Vegetation, Sediments, Mass wasting.
Identifiers: Scandinavia, Hillslopes.

A quaternary glaciated area of Sweden and a non-glaciated area of Pennsylvania were investigated for the evaluation of the stability of hillslopes. The studies conducted in Sweden show that the ice-lake shore lines at Lake Grovelsjon have been only very slightly deformed in 8000 years, indicating that solifluction, creep, and gullying can be rather weak, even on slopes of considerable inclination. Slopes with relatively high silt soil content are subject to much stronger processes of solifluction and mass wasting. The study of the Appalachian ridges of Pennsylvania indicates efficient mass wasting during cold Pleistocene tundra conditions and stability of slopes during the Holocene. In the evaluation of slope stability in the Pennsylvania area, it was assumed that the boulder strips are of the particular diagnostic value for this purpose. (Gabriel-USGS)
W70-01042

SOIL SLIPPAGE: AN INDICATOR OF SLOPE INSTABILITY ON CHAPARRAL WATERSHEDS OF SOUTHERN CALIFORNIA, Forest Service (USDA), Berkeley, Calif. Pacific Southwest Forest and Range Experiment Station. Robert G. Bailey, and Raymond M. Rice. Professional Geographer, Vol 21, No 3, May 1969, p 172-177. 6 p, 2 fig, 7 ref.

Descriptors: *Semiarid climates, *Chaparral, *Slope stability, *Accelerated erosion, *California, Root zone, Soil physical properties, Vegetation effects, Erosion, Landslides, Watersheds (Basins).
Identifiers: *Slippage.

Soil slips, small landslides involving only the material above the unweathered bedrock surface, are characteristic of the young, steep mountains of semiarid southern California and are a major erosional agent. The slips, associated with occasional intense high volume storms, strip substantial areas of soil and vegetative cover, causing downstream damage and adversely affecting local water supply. A study of slips on the San Dimas Experimental Forest showed that slope was the most important site characteristic associated with soil slips. The immediate slope on slips occurred was never less than 80%. Other important factors included the density and rooting depth of vegetative cover, soil physical properties, and soil depth (shallow soils were more likely to slip). In one storm slip erosions produced 81 cubic yds. per acre on slopes converted to shallow rooted grasses, whereas in adjacent deep-rooted chaparral areas 11 cubic yds. were eroded. (Crouse-Arizona)
W70-01196

SHEETFLOODS, STREAMFLOODS, AND THE FORMATION OF PEDIMENTS, Connecticut Univ., Storrs.

Perry H. Rahn. American Association of Geographers, Annals, Vol 57, No 3, Sept 1967, p 593-604. 12 p, 2 tab, 16 fig, 20 ref.

Descriptors: *Arid lands, *Geomorphology, *Erosions, *Sheet floods, *Floods, Streamflow, Arizona, Supercritical flow, Geologic formations, Rainfall-runoff relationships, Hydrology.
Identifiers: *Pediments, *Badadas.

Four summer floods were observed in the arid southern Arizona basin and range country. All were confined to pediments or badadas. Two characteristics of storm runoff were noted. Floods near or on pediments exhibited supercritical flow and were termed streamfloods. Thunderstorm runoff on the badadas manifested itself as sheet floods. Land surface of the pediments was found to be dissected by gullies, whereas badadas nearer the

center of the basins were of smoother, rolling topography. (Crouse-Arizona)
W70-01211

2K. Chemical Processes

ON THE HYDROGEOLOGY OF THE CENTRAL AND NORTHWESTERN PART OF THE DNEIPEL-DONETS ARTESIAN BASIN (UKRAINIAN)

Kharov State Univ., (USSR). G. M. Zakjarchenko, and V. P. Litvinov. English summary. Dopovidi Akad Nauk, Ukr, RSR, Ser B, Geol, Geofis, Khim, and Biol, No 7, p 582-586, 1969. 1 fig, 2 tab.

Descriptors: *Hydrogeology, *Groundwater basins, *Artesian wells, *Water chemistry, Aquifers, Boreholes, Stations, Sampling, Mapping, Sodium, Potassium, Carbonates, Chlorides, Magnesium, Salinity.

Identifiers: *USSR, Ukraine, Dnieper-Donets artesian basin.

Chemical composition of the Dnieper-Donets artesian basin water was analyzed by taking water samples at 13 localities. The 5 water types detected are: calcium bicarbonate, calcium-sodium-bicarbonate-sulfate, sodium bicarbonate, sodium chloride, and bicarbonate-sodium-chloride. (Gabriel-USGS)
W70-00866

THE RELATION OF ION MOVEMENT TO FINE PARTICLE DISPLACEMENT IN A SAND BED,

Georgia Inst. of Tech., Atlanta. For primary bibliographic entry see Field 05B.
W70-00909

TEMPORAL, HORIZONTAL AND VERTICAL VARIABILITY OF WATER CHEMISTRY IN UNSATURATED ZONE OF FINE-GRAINED SOILS,

Idaho Univ., Moscow. Water Resources Research Inst. For primary bibliographic entry see Field 05B.
W70-00911

DISTINGUISHING MARINE AND FRESH-WATER MUDS,

Illinois Geological Survey, Urbana; and Indiana Univ., Bloomington. N. F. Shimp, J. Witters, Paul Edwin Potter, and J. A. Schleicher. J Geol, Vol 77, No 5, p 566-580, Sept 1969. 15 p, 4 fig, 7 tab, 14 ref.

Descriptors: *Geochemistry, *Mud, *Clays, *Adsorption, *Trace elements, Sediments, Chemical properties, Water chemistry, Sampling, Data collections, Statistical methods, Regression analysis.
Identifiers: *Marine mud-fresh mud differences.

A wide sampling of 82 modern marine and freshwater muds was analyzed for B, Cr, Ga, Ni, V, clay, clay minerals, calcium carbonate, and organic carbon. Results show that total B is highly correlated with the amount of clay; for a given clay content, modern marine muds contain about 30-45 ppm more B than modern freshwater muds. Illite has little if any control on B concentration in muds. A discriminant function based on B and clay was found to be the most practical and effective combination for distinguishing between modern marine and freshwater environments. If a single differentiator is used, B is superior to clay content. The elements Cr, Ga, Ni, and V are not collectively good differentiators; clay minerals, calcium carbonate and organic carbon also fail to distinguish the 2 environments effectively. Data support the theory of Levinson and Ludwick (1966) that B in modern marine muds increases progressively seaward from a strandline as the amount of total clay increases. (Knapp-USGS)
W70-00994

FORMATION OF HYDROXY-AL AND -FE INTERLAYERS IN MONTMORILLONITE AND VERMICULITE: INFLUENCE OF PARTICLE SIZE AND TEMPERATURE,

Geological Survey, Washington, D.C. D. D. Carstean. Clays and Clay Minerals, Vol 16, p 231-238, 1968. 8 p, 3 tab, 30 ref.

Descriptors: *Clay minerals, *Aluminum, *Iron, *Montmorillonite, Particle size, Temperature, X-ray diffraction, Analytical techniques, Cation exchange, Spectrophotometry, Acidity, Moisture uptake, Mineralogy.

Identifiers: *Hydroxy-interlayer formation, Vermiculite.

This paper describes the influence of temperature and particle size upon the formation of synthetic hydroxy-Al and -Fe interlayers and shows applications to natural conditions in expanding clays. Hydroxy-Al and -Fe interlayers were prepared in 'mono-mineralic' fine and coarse clay montmorillonite and coarse clay and silt vermiculite at 3 deg C and 21 deg C. At comparable particle size and regardless of temperature, the amounts of hydroxy-Al and -Fe interlayers in montmorillonite exceeded by far those formed in vermiculite. Likewise, the aluminum systems exhibited a higher degree of interlayering than iron systems. Within montmorillonite, the amount of hydroxy-Al and -Fe interlayers increased as the particle size decreased, regardless of temperature. Within vermiculite systems equilibrated at 3 deg C, more hydroxy-Al interlayers were recorded in coarse clay than in silt fraction, whereas at 21 deg C about equal amounts of interlayers were formed. By contrast, hydroxy-Fe interlayer was favored by the silt fraction at both temperature levels. The formation of aluminum interlayers in both minerals increased with increasing temperature. The formation of hydroxy-Fe interlayers in montmorillonite was generally not temperature dependent, whereas the formation of such interlayers in vermiculite increased slightly with increasing temperature.
W70-01014

ON THE DIFFUSION PHENOMENA IN BOUNDARY LAYERS OF TURBULENT FLOW AND ITS INFLUENCE ON THE COURSE OF THE SELF-PURIFICATION OF SMALL STREAMS, For primary bibliographic entry see Field 05C.
W70-01037

CALCIUM CARBONATE INTERACTION WITH ORGANIC COMPOUNDS,

Lehigh Univ., Bethlehem, Pa. Marine Science Center.

Erwin Suess.

Available from the Clearinghouse for Sci and Tech Inf as AD-676 524 at \$3.00 in paper copy or \$0.65 in microfiche. A dissertation presented to the Grad Fac of Lehigh Univ in candidacy for Degree of Doctor of Phil in Geol Sci 1968. 153 p, 31 fig, 18 tab, 132 ref.

Descriptors: *Calcium carbonate, *Organic compounds, Carbonate rocks, Carbonates, Limestones, Seawater, Aqueous solutions, Aggregates, Environment, Phosphorus, Calcite, Diagenesis, Mineralogy, Adsorption, Organic matter, Deep water, Sediments, Connate water, Equilibrium, Dolomite, Hydrogen ion concentration, Free energy, Boundaries (Surfaces).

Identifiers: *Chemical processes, Albumin, Stearic acid, Aragonite, Concentration effects, Temporal effects, Monolayers, Half-layers, Surface-free energy, Calcite, Seawater ratios, Surface effects.

Dissolved organic compounds interact with surfaces of calcium carbonate minerals effecting equilibration between solution and solid. Demonstrable associations are: stearic acid and calcite and dolomite; albumin with aragonite, calcite, and magnesium-calcite. Carbonate minerals in hexane adsorb stearic acid with monolayer formation on calcite surfaces and half-layers on dolomite surfaces. Interaction is restricted to calcium sites of

Saline Water Conversion—Group 3A

solids and carboxyl acid groups. In aqueous solution, stearic acid adsorbed on carbonate mineral surfaces is insufficient to form a monolayer. Hydrated surface complexes are sufficient to cover surfaces of these minerals. Low aqueous concentrations of albumin form monolayers on carbonate minerals; greater concentrations, increasing time and pH, multilayers or non-oriented aggregates form on calcite and aragonite surfaces. Organocarbonate associations affect calcium carbonate equilibrium by physically isolating mineral surfaces, and by reducing surface-free energy of solids. Organic compounds containing phosphorus influence calcite-seawater interaction. At low calcite to seawater ratios (C/SR) adsorbed surface-active organic matter (stainable with methylene blue) is visible on calcite surfaces. At high C/SR, seawater is depleted of surface-active organic matter, equilibrating inorganically with carbonate minerals. Surface seawater, deep water, and interstitial water equilibrate inorganically at different C/SR, which are constant for each sample, whether equilibrium is approached from under- or oversaturation. (Simsman-Wisconsin)

W70-01069

PERSISTENCE OF DIAZINON AND ZINOPHOS IN SOIL: EFFECTS OF AUTOCLAVING, TEMPERATURE, MOISTURE, AND ACIDITY,
Western Washington Research and Extension Center, Puyallup.

L. W. Getzin.

Journal of Economic Entomology, Vol 61, No 6, p 1560-1565, Dec 1968. 8 fig, 3 tab, 11 ref.

Descriptors: *Diazinon, *Soils, *Insecticides, Persistence, Temperature, Moisture, Acidity, Microorganisms, Hydrogen ion concentration, Water pollution effects, Water pollution sources, Degradation (Decomposition), Biodegradation, Organophosphorus pesticides, Gas chromatography. Identifiers: *Zinophos, *Autoclaving effects, *Thermal effects, *Moisture effects, *Chemical processes, Sultan silt loam, Acidophilic organisms, Basiphilic organisms.

Effects were studied of autoclaving, temperature, moisture, and pH on diazinon and Zinophos persistence in a Sultan silt loam. Nonbiological degradation mechanisms were primarily responsible for breakdown of diazinon. Half-life of diazinon was 5 weeks in nonautoclaved soil and 6 weeks in autoclaved soil. Zinophos was degraded to a greater extent by microorganisms than diazinon. Half-life of Zinophos in the autoclaved and nonautoclaved soil was 9 and 2 weeks, respectively. Higher temperatures and soil moisture levels accelerated decomposition of both insecticides. The persistence of both insecticides was also influenced by soil pH but through different mechanisms. Nonbiological degradation of diazinon was shown to increase with increasing acidity, while pH had no effect on non-biological decomposition of Zinophos. However, biological decomposition of Zinophos was minimal at pH 5.5, increasing at higher and lower pH values; these data suggest that basiphilic and acidophilic organisms possess the capacity to degrade Zinophos. Attempts to show that soil accelerates the nonbiological decomposition of these insecticides were unsuccessful. (Graetz-Wisconsin)

W70-01079

A GROUNDWATER QUALITY SUMMARY FOR ALASKA,
Alaska Univ., College. Inst. of Water Resources.
For primary bibliographic entry see Field 04B.

W70-01087

DYNAMICS OF PHYSICOCHMISTRY IN A LARGE RESERVOIR,
Alabama Agricultural Experiment Station, Auburn.
J. M. Lawrence.
IN Reservoir Fishery Resources Symposium, Apr 5-7, 1967, Athens, Georgia, p 100-113, Nov 1968. 6 fig.

Descriptors: *Water chemistry, *Physicochemical properties, *Reservoirs, Currents (Water), Stratification, Thermocline, Oxygen, Circulation, Magnesium, Calcium, Water pollution, Density currents, Limnology, Dye releases, Water pollution sources, Hardness (Water), Iron, Carbon, Alabama, Georgia.

Identifiers: Walter F George Reservoir (Ala-Ga), Lake Eufaula (Ala-Ga).

Data are presented on stratification, density currents, dissolved oxygen content, total hardness, total iron concentration, and total carbon in Walter F George Reservoir (Lake Eufaula) during 1965 and 1966. Thermal and chemical stratification occurred during summer months, although partial or complete mixing occurred at least four times during both years after periods of cool, rainy weather. Retarded bottom currents, due to low-stream flow, facilitated stratification, and density currents existed in some regions when stratification prevailed. Use of fluorescent dye indicated that a causeway-type bridge caused upstream flowing currents. Total hardness was relatively low; the concentration of magnesium was fairly constant, while calcium concentration varied considerably among sampling sites. Concentration of total iron appeared to be associated with suspended particles. Concentrations of total carbon was high in one area due to organic pollution in 1965, but the source was largely eliminated by 1966. (Byrnes-Wisconsin)

W70-00890

2L. Estuaries**ANNOTATED BIBLIOGRAPHY ON HYDROLOGY AND SEDIMENTATION, 1963-65, UNITED STATES AND CANADA.**

Engineering-Science, Inc., Los Altos, Calif.
For primary bibliographic entry see Field 02J.

W70-00837

PHYSICAL MODELING OF REGIME OF BODIES OF WATER TO STUDY THEIR SANITATION CONDITION (IN RUSSIAN),
State Hydrological Inst., Leningrad (USSR).

For primary bibliographic entry see Field 05B.

W70-00885

MATHEMATICAL SIMULATION OF THE ESTUARINE BEHAVIOR AND ITS APPLICATIONS,

General Electric Co., Philadelphia; and Federal Water Pollution Control Administration, Philadelphia, Pa.

For primary bibliographic entry see Field 05C.

W70-00896

DISTINGUISHING MARINE AND FRESH-WATER MUDS,

Illinois Geological Survey, Urbana; and Indiana Univ., Bloomington.

For primary bibliographic entry see Field 02K.

W70-00994

03. WATER SUPPLY AUGMENTATION AND CONSERVATION**3A. Saline Water Conversion****ANALYSIS AND OPTIMIZATION OF A REVERSE OSMOSIS PURIFICATION SYSTEM—PART II. OPTIMIZATION,**

Kansas State Univ., Manhattan. Inst. for Systems Design and Optimization.

L. T. Fan, C. Y. Cheng, L. Y. S. Ho, C. L. Hwang, and I. E. Erickson.

Desalination, Vol 6, No 2, p 131-152, June 1969. 5 fig, 9 tab, 8 ref.

Descriptors: *Water purification, *Optimization, *Reverse osmosis, *Mathematical models, *Recirculated water, *Operating costs, Membrane processes, Design, Capital costs, Flow characteristics, Brines, Water supply.

Identifiers: Multistage operation, Flow-work exchanger.

A mathematical model of a reverse osmosis water purification system that could be used in process optimization studies had been developed in Part I of this study. In this part, the model was used to determine design and operating variables of the system, which minimized the cost of water production. Several three multistage reverse osmosis systems were considered. They were (1) a multistage operation without the use of a flow-work exchanger and with a variable membrane area at each stage, (2) a multistage operation without the use of a flow-work exchanger and with equal membrane at each stage, and (3) a multistage operation with the use of a flow-work exchanger and with variable membrane area at each stage. In the optimization study, the recirculation rate in each stage, the brine composition leaving each stage, the ratio of membrane area to feed at each stage, and the operating pressure in each stage were controlled to arrive at a minimum water production cost. The study showed that the method presented could be used to accomplish optimum designs of complex processes requiring the simultaneous optimization of several variables. (Thiuri-Cornell)

W70-00890

EXPERIMENTAL STUDY OF SLURRY SEPARATORS FOR USE IN DESALINATION,
Massachusetts Inst. of Tech., Cambridge. Dept. of Mechanical Engineering.

Joseph Schwartz, and Ronald Probstein.

Desalination, Vol 6, No 2, p 239-266, June 1969. 15 fig, 1 tab, 6 ref.

Descriptors: *Slurries, *Mathematical models, *Desalination processes, Optimization, Brines, Ice, Salt balance, Fresh water, Feasibility, Productivity. Identifiers: Freeze-distillation process, Counterwashers.

A mathematical model was developed and used to investigate the characteristics and performance of laboratory scale counterwasher slurry separators. The separators were of a type related to those used for the separation of brine from ice crystals in the freeze-distillation process. Polyethylene particles were used in the experiments to simulate the ice crystals. One of the main purposes of the experiments was to check out a model and the theory of such counterwashers previously developed by the authors. The experiments demonstrated the validity of the theoretical conclusions and helped to establish the optimal operating conditions for high production rates, sufficiently low salt content in the product and minimum loss of fresh water. The feasibility of obtaining high rates of crystal washing was demonstrated. The highest steady production rate obtained in the experiments was equivalent to 8000 lbs/hr ft of brine-free ice in the freeze-distillation process. This rate, however, was shown to be well below the maximum obtainable. (Thiuri-Cornell)

W70-00892

THE OPTIMUM TEMPERATURE FOR THE OPERATION OF A NON-SCALING MULTISTAGE FLASH EVAPORATOR PLANT,
California Univ., Richmond. Sea Water Conversion Lab.

Lester H. MacLeod, Abraham Gendel, and Ahmed F. ElSahrigi.

Sea Water Conversion Lab Rep No 63-1, Jan 1963. 42 p, 10 fig, 20 ref.

Descriptors: *Flash distillation, *Optimization, *Temperature control, *Sea water, *Mathematical models, Systems analysis, Economics, Thermodynamic behavior, Scaling, Fresh water.

Field 03—WATER SUPPLY AUGMENTATION AND CONSERVATION

Group 3A—Saline Water Conversion

A multi-stage flash distillation plant offered one of the most economical means of converting sea water to fresh water and was therefore, chosen as the subject of an optimization study. Mathematical equations were established which allowed the determination of the cost of heat, pumping power and heat exchanger surface per unit of product. Evaluation of these equations, in the absence of experimental sea water data beyond 212 deg F, required some extrapolation of sea water properties, using well established thermodynamic relationships. Based on this data, and the assumption of non-scaling system, it was concluded that the optimum temperature of the feed stream leaving the heater lies between 350 deg and 400 deg F, and that, by operating with this optimum temperature, it was possible to reduce the cost per thousand gallons of product by \$0.10 to \$0.15 below the cost for a plant with corresponding temperature of 210 deg F. (Thiuri-Cornell)
W70-00907

3B. Water Yield Improvement

OPTIMIZATION OF THE LONG-TERM OPERATION OF A SINGLE-PURPOSE RESERVOIR,

Belgrade Univ. (Yugoslavia).

Slavoljub Jovanovic.

Proc, Int Hydrol Symp, Vol 1, Colo State Univ, p 422-429, Sept 1967. 8 p, 3 fig, 6 ref.

Descriptors: *Optimization, *Reservoir operation, *Markov processes, *Linear programming, *Long-term planning, Optimum development plans, Dams, Storage capacity, Hydroelectric plant.

Identifiers: Single-purpose reservoir, Howard's algorithm.

The analysis of an optimum operating policy for a single-purpose reservoir was presented. It was assumed that water could be released from the dam through different alternatives (decisions) and that sequential decisions formed an operating policy. Linear programming and Markov chain techniques were used for selecting the policy which maximized the average release of water from the dam in long term operation. Howard's algorithm made it possible to find the optimum policy by means of relatively low number of iterations. The model was applied to a storage hydroelectric plant as an example. (Thiuri-Cornell)
W70-00901

A WATER YIELD MODEL DERIVED FROM MONTHLY RUNOFF DATA,

Office of Tributary Area Development, Knoxville, Tenn.

Willard M. Snyder.

World Meteorol Organ Int Ass Sci Hydrol Symp, Berkeley, p 18-30, Aug 1963. 13 p, 2 fig, 3 tab, 4 ref.

Descriptors: *Water yield, *Mathematical models, *Streamflow, *Watershed management, *Rainfall-runoff relationships, Least squares method, Numerical analysis, Optimization, Evaporation pans, Seasonal.

A mathematical model was developed to analyze past records of streamflow and to predict dependable yield for watersheds under varying patterns of rainfall. The model contained three parts: (1) a seasonal rainfall function that generated potential runoff in two phases; immediate and delayed, (2) a distribution function that delivered the delayed runoff to future streamflow, and (3) a time-trend function that compensated for changing watershed conditions. Ten test sets of data were analyzed. The model was fitted to the data by composite techniques of non-linear least squares and component analysis. This method of numerical analysis produced consistent results. Seasonal losses corresponded closely in both magnitude and phasing to expected values based on pan evaporation. The time-trend function did not produce satisfactory

results. The yield study was an effort to produce another tool or measuring technique that was necessary for optimum and unified development. (Thiuri-Cornell)
W70-00905

A HYDROGEOPHYSICAL SURVEY FROM KAWAIHAE TO KAILUA-KONA, HAWAII, Hawaii Univ., Honolulu. Water Resources Research Center.

William M. Adams, Frank L. Peterson, Surendra P. Mathur, Larry K. Lepley, and Clifton Warren. Available from the Clearinghouse as PB-187 520, \$3.00 in paper copy, \$0.65 in microfiche. Hawaii Water Resources Research Center, Technical Report No 32. Sept 1969. 156 p. OWRR Proj B-011-HI.

Descriptors: Hydrogeophysical, Aeromagnetic, Infrared, Audiagnetotellurics, Electrical resistivity, Thermal anomalies, Brackish water, Basal groundwater, Resistivity profiling, Hawaii, Kawaihae, Kailua-Kona, Reconnaissance, Development.

Several geophysical surveys have been conducted over the coastline area between Kawaihae and Kailua-Kona for the purpose of locating the optimum sites for possible development of groundwater from the basal lens. A low-level aeromagnetic survey over the area and an infrared scanning effort along the coast with surface verification provided general reconnaissance information. Audiagnetotelluric and D. C. electrical resistivity profiles defined more detailed, local structures. The infrared scanning survey along the coastline did not reveal any thermal anomalies that are reasonably attributable to previously unknown outflows of brackish water of magnitudes adequate for currently anticipated commercial exploitation. However, the aeromagnetic and audiagnetotelluric surveys locate four lines which are possible barriers to lateral movement of basal ground water. The D. C. electrical resistivity profiling was conducted at an elevation of about 100 feet or less. Based on the resistivity data, three possible sites are selected -- two are in the north near Puako Bay and the other is above the present Kona Airport. W70-00908

VILLAGE WATER SUPPLY INVESTIGATION, TERRITORY OF PAPUA AND NEW GUINEA,

Bureau of Mineral Resources, Geology and Geophysics, Canberra (Australia).

J. P. MacGregor, and J. R. L. Read.

Eng Geol, Vol 3, No 3, p 217-232, July 1969. 16 p, 5 fig, 3 ref.

Descriptors: *Water supply, *Municipal water, *Domestic water, *Water resources development, Water wells, Aquifers, Water quality control, Canals, Wellpoints, Water yield.
Identifiers: *New Guinea.

The Territory of Papua and New Guinea has water supply problems despite its relatively high rainfall. The population lives mostly in villages and obtains its drinking water from streams and wells that are subject to pollution and drought. A Village Water Supply Team was set up to review the present position district and make recommendations for the development of water supplies. Any village water supply scheme recommended must be cheap to install and maintain and should provide an adequate supply of fresh water which cannot readily be polluted. Deep drilling is too expensive to provide a solution at this stage of development. It has been found that supplies of fresh water can be obtained in, or near, most villages and settlements by sinking a protected large diameter well or by tapping a sandy aquifer. Water from surface streams can be gravitated to a village in appropriate situations provided bacterial contamination can be avoided. Where suitable groundwater cannot be located an artificial rainwater catchment and storage is generally the best alternative. (Knapp-USGS)
W70-00991

OPTIMIZATION TECHNIQUES IN WEATHER MODIFICATION,

Denver, Colo.

P. J. Stinson.

Proc Ser No 5, Proc Nat Symp Analysis Water-Resour Syst, p 79-94, July 1968. 16 p, 8 fig, 11 ref.

Descriptors: *Weather modification, *Optimization, Water requirements, Water resources, Dry ice, Technology, Precipitation (Atmospheric), Legal aspects, Meteorology, Mathematical models, Simulation, Systems analysis, Social aspects, Economics, Mathematics, Cloud seeding, Silver iodide, Weather data, Nucleation, *Operations research, Atmospheric physics.
Identifiers: Cloud modification, *Atmospheric research, Ice crystals, Nuclei generators, Systems engineering.

Precipitation management research programs offer a complex system including scientific and engineering developments and much human ingenuity. Maximum effectiveness can be achieved best through the optimization of a sequence of processes and their interactions including: (1) cloud systems, (2) cloud treatment systems, (3) experimental design and statistical evaluation of precipitation data, (4) computer simulation and mathematical modeling, and (5) the total system. Each optimization process in the sequence produces a beneficial result and in combination with other processes in the sequence produces the most effective enhancement of water supply. The ultimate system involves a scientific, interdisciplinary approach including systems engineering, systems analysis, and other operations research techniques. (USBR)
W70-01122

THE LAND AND WATER USE SURVEY OF NORTH-CENTRAL KORDOFAN (1961-66), London Univ. (England). School of Oriental and African Studies.

J. H. G. Lebon.

Geographical Journal, Vol 134, No 4, Dec 1968, p 546-550. p 5, 14 ref.

Descriptors: *Arid lands, *Grazing, *Surveys, Social impact, Maps, Grasslands.

Identifiers: *Sudan, *Kordofan, *Catchments, Africa.

The article reviews a series of F.A.O. reports on land and water use in Kordofan Province, Republic of Sudan. Kordofan is located in the drier savanna zone of Africa which has a severely limited perennial water supply. The area is economically retarded, with both grazing and the limited agriculture tending to concentrate in the few areas where water is available perennially. Hence, pasture and soils are deteriorating. Work is underway to develop catchment and cistern systems for the drier northern area where no subsurface water is available. Some of the area does support the well adapted Acacia senegal and research is underway to improve output of gum arabic. The reports present general maps of resources of the area and review practices of the largely pastoral and nomadic tribes that inhabit it. These may serve as bases for future resource and social research and development. (Crouse-Arizona)
W70-01198

WATER SUPPLIES IN SOUTH AUSTRALIA,

Hull Univ. (England). Dept. of Geography.

Peter Crabb.

Geography, Vol 53, No 3, 1968, p 282-293. 12 p, 4 fig, 6 tab, 16 ref.

Descriptors: *Arid lands, *Irrigation, *Water resources development, *Water transfer, *Reservoirs, Water supply, Consumptive use, Municipal water, Rivers, Desalination.

Identifiers: *Australia, *South Australia, River Murray.

Four-fifths of South Australia has an average precipitation of less than 10 inches. A long term

WATER SUPPLY AUGMENTATION AND CONSERVATION—Field 03

Conservation in Industry—Group 3E

development program, reviewed in this paper, has made essentially unrestricted water use available to most of the state's population of over one million. An intricate system of diversions, reservoirs, inter-basin transfers and groundwater pumping started in the mid-19th century has supported continuous population and economic growth of the Adelaide metropolitan area. Problems of water supply for rural parts of the state, distant from the Adelaide Hills, are somewhat more difficult; every possible stream, intermittent or otherwise, has been exploited, including long transfers from the River Murray lying to the east. A solar distillation plant converts saline groundwater for one mining community. New storage and diversion projects along the Murray will support some additional development, but beyond that desalination of sea water will be necessary. (Crouse-Arizona)
W70-01204

THE WATER PROBLEM IN THE DESERTS OF THE USSR,

All-Union Research Institute for Water Engineering and Reclamation, Moscow.

L. V. Dunin-Barkovskiy.

Trans from *Problemy Osvoyeniya Pustyn*, No 1, 1967, p 13-22. Soviet Geography: Review of Translation, Vol 9, No 6, 1968, p 458-468. 11 p, 7 ref.

Descriptors: *Arid lands, *Irrigation programs, *Salinity, *Water improvement, *Deserts, Weather modification, Drainage systems, Phreatophytes, Evaporation control, Saturated soils, Desalination. Identifiers: *USSR.

The author reviews existing and planned irrigation projects in arid and semiarid regions of the USSR. There is great potential for irrigation based on water from rivers transversing the vast arid region. To the west, waters of rivers such as the Volga, used largely for power generation and transportation until now, are expected to support large irrigation projects in the future. The Eastern and north eastern deserts have limited flow available for irrigation projects. Such development would require diversion of water from distant Siberian streams. In some cases desalination of present surface and groundwaters or weather modification might be reasonable alternatives. Central Asia and Kazakhstan which have 2/3 of the present irrigated land in the U.S.S.R., offer great potential with better regulation of melt water flows from the major mountain ranges. Control of phreatophytes and of evaporation from surface waters offer a real potential for improving stream flow. Water logging and salinity problems in currently irrigated areas indicate need for better drainage planning in future projects. (Crouse-Arizona)
W70-01215

THE STUDY OF LOCAL WATERS IN THE DESERTS OF THE USSR,

Akademiya Nauk SSSR, Moscow. Institut Geografii.

V. N. Kunin.

Trans from *Problemy Osvoyeniya Pustyn*, No 5, 1967, p 40-56. Soviet Geography: Review and Translation, Vol 9, No 6, 1968, p 469-488. 20 p, 67 ref.

Descriptors: *Arid lands, *Underground storage, *Recharge, *Perched water, *Deserts, Grazing, Impervious soils, Confined water, Groundwater basins, Surface waters, Runoff, Hydrogeology, Fresh water, Water resources development. Identifiers: *USSR, *Catchments, Takrys.

The author presents a broad review of current knowledge and of the potential of fresh water sources in desert regions of the U.S.S.R. These could be used for watering livestock herds, herder's settlements, and suitable industrial enterprises. Intensive agricultural use in large irrigation projects, except to meet limited local needs, is generally discouraged. There is insufficient recharge in most areas to maintain such projects over the long run. One of the most promising approaches, both

economically and technically, is the use of clay plans as catchments for recharge of natural aquifers or artificial storage tanks. Large areas are found to have fresh water lenses perched on deeper saline ground water. With proper development so as to prevent salt water intrusion, these could prove useful and more economical for watering livestock than deep wells requiring long lifts. Artesian sources located far from recharge areas have generally been saline. (Crouse-Arizona)
W70-01216

3C. Use of Water of Impaired Quality

WATER QUALITY AND REGIONAL ECONOMY, A DECISION MODEL,
Pennsylvania State Univ., University Park. Inst. for Research on Land and Water Resources.
For primary bibliographic entry see Field 05G.
W70-00897

GASES FOR THE FUTURE,
Rochester Inst. of Tech., N.Y.
For primary bibliographic entry see Field 06B.
W70-01203

EFFECTS OF EXTERNAL SALT CONCENTRATIONS ON WATER RELATIONS IN PLANTS: SIGNIFICANCE OF EXTERNAL WATER-POTENTIAL AND SALT-TRANSPORT KINETICS ON RATE OF CELL EXPANSION,
California Univ., Riverside.
For primary bibliographic entry see Field 02I.
W70-01214

3D. Conservation in Domestic and Municipal Use

HAS RECENT LEGISLATION LIMITED PRIVATE RIPARIAN RIGHTS IN IOWA,
Keith McKinley.

Drake L Rev, Vol 8, No 1, p 59-65, Dec 1958. 7 p, 52 ref.

Descriptors: *Iowa, *Riparian rights, *Preferences (Water rights), *Water allocation (Policy), Legislation, State governments, Water rights, Artificial use, Irrigation water, Legal aspects, Natural use, Relative rights, Water law, Water utilization, Competing uses, Regulated flow, Consumptive use, Water management (Applied), Water permits, Water policy, Water supply, Withdrawal, Water demand, Water resources, Regulation, Priorities, Average flow.

Recent Iowa legislation regulating the consumptive use of water resources has not substantially changed the common law rights of private riparian owners as developed by the Iowa Supreme Court. While creating a new right in non-riparian users, the rights of riparian owners have not been limited. Riparian owners still have unlimited use of water resources for ordinary and natural uses, termed non-regulated uses by the legislature. Artificial, or regulated, use is still limited to the extent that there is to be no interference with natural uses by other riparians. Although any person may apply for a permit to withdraw water, the rights of non-riparians are clearly inferior to the rights of private riparian owners. As between two non-riparian applicants, the first in time is given priority. The new legislation preserves the common law rights of riparians, yet it provides for maximum utilization of water resources by making water available to non-riparian users for the first time. (Doublerley-Florida)
W70-01133

RHODE ISLAND WATER RESOURCES BOARD.
For primary bibliographic entry see Field 06D.
W70-01187

RHODE ISLAND WATER RESOURCES BOARD.
For primary bibliographic entry see Field 06D.
W70-01188

RHODE ISLAND WATER RESOURCES BOARD.
For primary bibliographic entry see Field 06D.
W70-01189

RHODE ISLAND WATER RESOURCES BOARD.
For primary bibliographic entry see Field 06D.
W70-01190

WATER POWER AND RESOURCES.
For primary bibliographic entry see Field 06B.
W70-01192

3E. Conservation in Industry

FISH, OYSTERS, SHELLFISH, AND OTHER MARINE LIFE: MARINE RESOURCES COMMISSION AND COMMISSIONER OF MARINE RESOURCES.
Va Code Ann secs 28.1-1 thru 28.1-22 (1969).

Descriptors: *Virginia, *Fish, *Oysters, *Commercial fishing, Administrative agencies, Administration, Commercial shellfish, Commercial fish, Taxes, Fish conservation, Fish management, Permits, Inspections, Surveys, Legal aspects, Legislation, Tidal waters, Regulation. Identifiers: Seafood industry, Oyster repletion.

The counties which make up 'tidewater Virginia' are enumerated herein. The Commission of Fisheries is renamed the Marine Resources Commission. The chairman is to be appointed by the governor and must have knowledge of seafood and marine affairs. The Commissioner is responsible for enforcement of the fish and shellfish laws and those laws related to the fish and shellfish industries in the tidewaters of the state. The Commissioner, with Commission approval, may purchase or rent such equipment as may be required to perform his duties. The Commissioner is obligated to investigate all matters affecting the seafood industry and to make reports on revenues derived from the shellfish industries, the condition of those industries, and possible legislation aimed at betterment or protection of them. No employee or official of the Commission may be granted a license to engage in commercial fishing in Virginia. The Commission shall appoint civil engineers to make surveys of all oyster-planting grounds and of natural oyster beds or shoals as necessary. The Commission shall also appoint a conservation and repletion officer to head the oyster and shellfish repletion program. (Kelly-Florida)
W70-01161

MARINE RESOURCES COMMISSION.

Va Code Ann secs 28.1-23 thru 28.1-36 (1969).

Descriptors: *Virginia, *Marine fisheries, *Fish conservation, *Administrative agencies, Legislation, Legal aspects, Regulation, Permits, Public health, Natural resources, Shellfish, Fishing, Commercial fishing, Supervisory control (Power). Identifiers: *Marine resources, *Seafood industry, Penalties (Criminal).

The Marine Resource Commission is authorized to make such regulations as it deems necessary to promote the general welfare of the seafood industry and to conserve and promote the seafood and marine resources of the state. The Commission may regulate the taking of seafood so long as such regulations do not conflict with the provisions of statutory law. The Commission is empowered to establish licenses for the use of devices used to take seafood commercially. Violation of Commission

Field 03—WATER SUPPLY AUGMENTATION AND CONSERVATION

Group 3E—Conservation in Industry

regulations is punishable by criminal penalties. Regulations must be published in a specified manner before promulgation in order that public hearings can be held, except emergency regulations of limited duration may be adopted without publication where necessary for the immediate preservation of the public peace, health, safety, welfare, protection of the seafood industry, or natural resources or marine animals. The procedure at hearings on proposed Commission regulations is provided for. Judicial review of Commission decisions at the hearings and of the regulations themselves is established. (Keith-Florida)
W70-01162

SURVEYS OF AND RIGHTS IN OYSTER GROUNDS.

Va Code Ann secs 28.1-100 thru 28.1-107 (1969).

Descriptors: *Virginia, *Oysters, *Administrative agencies, *Surveys, Maps, Mapping, Shellfish, Commercial shellfish, Commercial fishing, Beds under water, Conservation, Shoals, Bays, Legislation, Regulation, Jurisdiction, Local governments, Legal aspects.
Identifiers: Oyster beds.

The Baylor Survey, which is the official survey of oyster grounds in this state, may be changed or resurveyed by the Commission of Fisheries. Copies of Commission maps showing oyster grounds must be filed with the clerk of the county or city having jurisdiction over the respective underwater areas. If a surveying mistake places part of an oyster-planting ground in a natural oyster bed, the leaseholder of the planting grounds may remove his oysters upon obtaining Commission approval. Oyster grounds should be designated by prominent markers. It is unlawful to remove any oyster-ground markers or for any person other than the leaseholder to remove oysters from an oyster ground. (McDonough-Florida)
W70-01163

LEASING OYSTER-PLANTING GROUNDS.

Va Code Ann secs 28.1-108, 28.1-109 (1969).

Descriptors: *Virginia, *Riparian rights, *Oysters, *Commercial shellfish, Commercial fishing, Administrative agencies, Surveys, Bays, Bodies of water, Legislation, Leases, Fisheries, Fish management, Rivers, Legal aspects, Water law.
Identifiers: Oyster beds.

Riparian owners owning land bordering on oyster-planting areas may apply for oyster grounds in front of their land. The leasing of oyster grounds is recorded, and the leasehold of a riparian owner passes with the sale or transfer of the riparian land. State residents, firms, and domestic corporations in the oyster business may lease oyster grounds from the Commission of Fisheries. Applications for leases should state the location and number of acres of the oyster ground desired. Except in the Chesapeake Bay, no single assignment of oyster grounds may exceed two hundred fifty acres, and no combined allotment to any person, firm, or corporation may exceed three thousand acres. Leases are for twenty years and may be renewed. Leaseholders' rights to oyster grounds are subject to riparian rights and fishing rights. (McDonough-Florida)
W70-01164

TRANSFER OF OYSTER-PLANTING LEASES; RIGHTS OF RIPARIANS.

Va Code Ann secs 28.1-110 thru 28.1-118.1 (1969).

Descriptors: *Virginia, *Oysters, *Commercial shellfish, *Riparian rights, Leases, Administrative agencies, Local governments, Navigation, Highways, Legislation, Legal aspects, Oysters,

Eminent domain, Conservation, Fisheries, Fish management, Water law, Beaches, Ownership of beds, Beds.
Identifiers: Oyster-planting grounds.

No person may use natural oyster grounds or bottoms not assigned to him. Lease-holders of oyster-planting grounds may transfer or assign their leases to state residents and domestic corporations in the oyster business. A transfer creates a new twenty-year lease and includes the balance of time remaining under the assigned lease. The Commission of Fisheries may decide not to collect rents for oyster grounds in disaster areas for oyster culture. The state highway and conservation departments and municipalities have eminent domain rights to any oyster bottoms within their respective jurisdictions. Riparian owners owning land surrounding creeks, coves, or inlets less than one hundred yards wide have exclusive shelfish-planting rights to the bottom. Leaseholders may erect oyster watchhouses that do not obstruct navigation. Leases to oyster grounds are subject to the rights of riparian owners wishing to build bulkheads or wharves in front of their land. Any person may apply to the Commission for a permit to establish a bathing beach. (McDonough-Florida)
W70-01165

CULLING OYSTERS.

Va Code secs 28.1-124 thru 28.1-127 (1969).

Descriptors: *Virginia, *Oysters, *Commercial shellfish, *Administrative agencies, Legislation, Commercial fishing, Conservation, Fish management, Legal aspects, Size, Public rights, Shellfish, Regulation, Control.

Oysters taken from public, natural oyster beds must be culled at the place of taking. Shells under the statutory length must be replaced. It is unlawful to buy, sell, or possess oysters under the prescribed size. Catchers violating oyster size requirements may be required to scatter their entire cargo onto the public oyster rocks or post a cash bond. Throwing oysters or shells overboard (other than in the ordinary process of culling) upon the approach of an oyster inspector is evidence of violation of this chapter. (McDonough-Florida)
W70-01166

RHODE ISLAND WATER RESOURCES BOARD.

For primary bibliographic entry see Field 06D.

W70-01187

RHODE ISLAND WATER RESOURCES BOARD.

For primary bibliographic entry see Field 06D.

W70-01188

RHODE ISLAND WATER RESOURCES BOARD.

For primary bibliographic entry see Field 06D.

W70-01189

RHODE ISLAND WATER RESOURCES BOARD.

For primary bibliographic entry see Field 06D.

W70-01190

WATER POWER AND RESOURCES.

For primary bibliographic entry see Field 06B.

W70-01192

WATER RESOURCES AND THE CHEMICAL INDUSTRY IN NEW JERSEY: AN ECONOMETRIC AND ENGINEERING ANALYSIS.

Rutgers - The State Univ., New Brunswick, N.J. Water Resources Research Inst.

For primary bibliographic entry see Field 06D.

W70-01217

3F. Conservation in Agriculture

EFFECTS OF CULTIVATION AND GRASS ON SURFACE RUNOFF,
Agricultural Research Service, Coshocton, Ohio.
Corn Belt Branch.
For primary bibliographic entry see Field 04A.
W70-00863

SIMULATION OF RUNOFF FOR DESIGN OF WATER RESOURCE SYSTEMS,
State Water Plan Development of Water Resources Management, Prague (Czechoslovakia).
For primary bibliographic entry see Field 04A.
W70-00900

PAT HARRISON WATERWAY DISTRICT.
For primary bibliographic entry see Field 05G.
W70-00958

PAT HARRISON WATERWAY DISTRICT.
For primary bibliographic entry see Field 05G.
W70-00959

PAT HARRISON WATERWAY DISTRICT.
For primary bibliographic entry see Field 05G.
W70-00960

A PHYSICAL AND ECONOMIC ANALYSIS OF ALTERNATIVE IRRIGATION METHODS IN A SUB-HUMID CLIMATE,
North Dakota State Univ., Fargo.
E. C. Stegman, G. A. Johnsgard, A. Bauer, and D. O. Anderson.

Available from the Clearinghouse as PB-187 684, for \$3.00 in paper copy, \$0.65 in microfiche. Research Project Technical Completion Report, Sept. 1969. 60 p, 16 tab, 12 fig, 72 ref. OWRR Proj B-007-NDAK.

Descriptors: *Irrigation system design, *Alternative irrigation methods, Irrigation program simulation, Crop production functions, Irrigation economic analysis, Irrigation.

The question of on-farm system investment levels which are needed to produce near optimum returns is a difficult and relevant design problem for irrigation system planners. This question is particularly relevant to many humid and sub-humid areas where crops can be profitably produced without irrigation. The methodology of this project has centered upon the development of computational models which simulate in detail the operation of specific types of sprinkler irrigation systems. These models are being applied to the long term climatic record of a test area (Oakes Irrigation District of North Dakota) to compute probability distributions of parameters (i.e. number of irrigations, days of system operation, acre inches of water pumped, crop yield potential, etc.) which may be utilized to evaluate the physical and economic potential associated with specific system types, capacities, and imposed management regimes. The computational models are being applied to combinations of physical parameters (soils, crops, and irrigated unit size) which are expected to be representative of the test area during early stages of irrigation development. Relevant cost and return functions may then be applied for economic analysis either as a second phase to this project or at such time a planner is in need of such analysis. This report describes the development of the computational models and associated analyses relative to the test area and the selection of model inputs. These analyses include: (1) The identification and selection of physical conditions representative of the Oakes Irrigation District; (2) The development of crop production functions; (3) The development of computer simulation models for specific sprinkler system types; (4) Example model applications.
W70-01086

WATER SUPPLY AUGMENTATION AND CONSERVATION—Field 03

Conservation in Agriculture—Group 3F

NEW WATER BIRD FOR EGYPT: A ROBOT SHADOOF,
Rand Corp., Santa Monica, Calif.
Richard Murrow.
Ekistics, Vol 24, No 142, p 256-260, 1968. 5 p, 2 fig.

Descriptors: *Arid climates, *Irrigation operation and maintenance, *Water conveyance, *Farm equipment, Irrigation efficiency.
Identifiers: *Egypt, *Shadoof.

The shadoof is an ancient and simple man-operated fulcrum device which lifts water from an irrigation canal into the irrigated field. It is the most preferred irrigation device in Egypt but is enormously wasteful of man power. The common toy 'drinking bird' alternately bobs forward into drinking position, then returns to erect standing position in an endless cycle. This engine requires virtually no service or attendance and involves little frictional wear to create demands for lubrication or replacement. High Nile Valley temperatures offset by drying winds should keep a 'bird' going virtually indefinitely. The author added a tube with a scoop near the head which would scoop up water as from a canal and carry it backward through the tube to be dumped into another container at a higher level, such as the Egyptian field. A laboratory model seven feet in length using Freon 11 as the internal working fluid has performed successfully. Using proper materials such an engine could be built for a cost of \$50 to \$100, be portable, and perform efficiently the work of a man scooping up water each day. (Crouse-Arizona)

W70-01205

ESTIMATION OF GRAZING CAPACITY ON ARID GRAZING LANDS,
Soil Conservation Service, New South Wales.
R. W. Condon.
IN G. A. Stewart, Ed., Land Evaluation, Papers of a CSIRO Symposium Organized in Cooperation with UNESCO, Macmillan of Australia, p 112-124, Aug 26-31, 1968. 13 p, 4 fig, 7 ref.

Descriptors: *Arid lands, *Grazing, *Land classification, *Rainfall, *Pasture management, Soil types, Topography, Soil-water-plant relationships, Carrying capacity, Range management, Stocking, Estimating.
Identifiers: *Australia, *New South Wales, Vegetation density.

The author describes a method developed for estimating safe grazing capacity for arid lands in Australia. Rating scales were established for factors influencing grazing capacity. Those factors increasing capacity were given a plus rating; those with an adverse effect, a penalty rating. It was necessary to establish the capacity for a base or standard land class and rating scales for the factors that would influence variance from the standard unit. Such factors as soils, topography, and density of woody species were rated, but the most important single variable was average annual rainfall. (Crouse-Arizona)

W70-01206

COMMUNITY IRRIGATION PROJECTS IN THE WAIKERIE DISTRICT OF SOUTH AUSTRALIA,
Hull Univ. (England).
P. Crabb.
Geography, Vol 52, No 4, p 412-415, Nov 1967. 4 p, 1 fig, 2 tab.

Descriptors: *Arid lands, *Sprinkler irrigation, *Horticultural crops, Salinity, Drainage, Evaporation, Irrigated land, Irrigation programs, Citrus fruits.
Identifiers: *Australia, *Murray River, South Australia.

Over 3,000 acres of the Waikerie District of South Australia have been irrigated since 1960. This land is well above the river level and in no danger of being flooded as had been earlier developed low

lands. The area of deep sandy soils is not suited to furrow-irrigation; therefore, a sprinkler irrigation system has been developed. Irrigation is managed on a community cooperative basis rather than by individual land holders. Most of the land is in orchards with some vineyards, and vegetables presently grown among the developing fruit trees. Much of the land is controlled by absentee owners but with resident managers. There are some difficulties with periodic salinity of Murray river waters causing leaf poison and potential drainage problems, resulting in decreased production and fluctuation in the fruit market. However, the author concludes that undoubtedly the projects will be technically and economically successful. (Crouse-Arizona)

W70-01207

THE KHASHM EL GIRBA IRRIGATION SCHEME: A NEW SOCIO-ECONOMIC project in the sudan,
Khartoum Univ. (Sudan).
Mutwakil A. Amin.
Professional Geographer, Vol 21, No 3, May 1969, p 150-152. 3 p, 1 fig, 2 ref.

Descriptors: *Semiarid climates, *Irrigation programs, Rural sociology, Economics, Social aspects, Relocation, Agriculture, Dam construction, Rotations, Cotton, Land tenure, Sugarcane, Wheat.
Identifiers: *Sudan, Aswan High Dam.

The article briefly describes relocation of a Nubian community flooded by the Aswan High Dam to semiarid land east of Khartoum. Since rainfall occurs within a month period, a diversion dam with an irrigation project was developed to conserve water and sustain the relocated group of some 32 thousand persons. The soil was a deep fertile clay which with addition of a dependable water supply appears to be able to support a viable agricultural community based on cotton and sugar for export and wheat and vegetables for local consumption. Ownership and farm management activities are divided between settlers and the government according to availability of capital and technical abilities. The settlers are grouped into several villages in an attempt to preserve their former social structures. (Crouse-Arizona)

W70-01208

REGIONAL AND SEASONAL WATER SUPPLY IN THE TARIM BASIN AND ITS RELATION TO CULTIVATED LAND POTENTIALS,
Hawaii Univ., Honolulu.
Herold J. Wiens.

Assn of Amer Geographers, Annals, Vol 57, No 2, June 1967, p 350-366. 17 p, 1 tab, 3 fig, 61 ref.

Descriptors: *Arid lands, *Irrigation programs, *Melt water, *Water yield improvement, *Low-flow augmentation, Agriculture, Salinity, Evaporation, Irrigation canals, Channeling, Drainage programs, Flow rates, Flow control, Rice, Wheat, Glaciers, Snow melt, Deserts, Water resources development.
Identifiers: *China, *Sinkiang, *Tarim basin, Timing (Flow), Oases.

The Tarim Basin in Sinkiang is one of the more important areas where China's Communist regime is finding that application of efficient technology can be effective in increasing usable land and conserving irrigation water. Since rainfall averages less than two inches per year, agriculture depends upon irrigations from glacier and snow melt from the high surrounding mountains. Streams flowing from the mountains carry an annual flow estimated at about 89 billion cubic meters. This is a basis for an estimate of potential limit on agricultural production in the Basin. Summer flows account for fifty to eighty percent of the annual flow. Because of inadequate storage and poor drainage in many irrigated areas, full potential of the water supply has not been realized. Much water is lost to evaporation. Developed cropland in 1963 was seven million acres. With improved technology a potential of 11 million acres is estimated. (Crouse-Arizona)

W70-01210

THE DEVELOPMENT OF THE IRRIGATION ECONOMY OF MENDOZA, ARGENTINA,
Glasgow Univ. (Scotland).
Arthur S. Morris.

American Association of Geographers, Annals, Vol 59, No 1, Mar 1969, p 97-115. 19 p, 10 fig, 30 ref.

Descriptors: *Arid lands, *Irrigated land, *Land tenure, *Economics, *Agriculture, Irrigation efficiency, Diversion dams, Canal seepage, Groundwater, Deep wells, Water costs, Vine crops, Agronomic crops, Water law.
Identifiers: *Argentina, *Agricultural development, Mendoza.

The area around Mendoza in western Argentina is extremely arid but has experienced agricultural development based on irrigation using both surface and groundwater originating in the nearby Andes. The area near Mendoza is the oldest in terms of agricultural development and having a longer growing season, is devoted to vineyards. The farms tend to be small and technologically backward. Share cropping with short-term tenancy is common. Water is supplied by canals from diversion dams, with the amount of water determined by natural river flow. These factors discourage long term investment in technological improvement on crop diversification. More recently developed outlying areas, while less favored by climate, have tended toward more stable ownership of larger holdings, technological improvements and crop diversification. These lands depend to a large extent upon modern wells, which are costly but assure a more dependable supply of water. The landowner is encouraged to invest in technology and diversified crop varieties that will make the most economical use of his water. Recent beginning of large storage dams will probably lead to further development of modern agriculture. (Crouse-Arizona)

W70-01213

TRICKLE IRRIGATION -- A PROMISING SECOND TOOL FOR A BREAKTHROUGH IN FOOD PRODUCTION IN TROPICAL, SUB-TROPICAL AND DESERT AREAS,
Food and Agriculture Organization of the United Nations, Bangkok (Thailand).

B. D. van't Woudt.

International Commission on Irrigation and Drainage Bull, p 88-96, July 1968. 7 p, 2 fig, 1 tab, 8 ref, append.

Descriptors: Irrigation, *Irrigation systems, *Irrigation practices, *Hydroponics, *Fertilizers, Crops, Crop production, Saline water, Costs, Drops (Fluids), Foreign research, Agriculture, Agronomic crops, Soil moisture, Agronomy, Salinity, Automatic control.
Identifiers: Israel, Saline agriculture, Trickle irrigation.

A method developed in Israel through which a water-fertilizer mix is continuously dripped on the soil at the base of a crop plant under field conditions is discussed. Noncorrosive plastic tubes are placed on the ground next to the base of crop plants; no soil levelling is required. The tubes, which can be permanent installations, continually drip water-fertilizer mix to plant roots. Control head units with water tap and filter, water meter, and fertilizer tank are located about every 5 acres. The unit requires about 2.5 gal/hr and the system takes 1 to 2.3 atm of pressure. Early results, conclusions from related work, and field observations show that this method may produce high yields, allow water of high salinity to be used, reduce drainage problems, and permit complete automation under field conditions in such a way that water and fertilizer applications meet but not exceed plant needs. Although the cost of installation varies from \$1000 to \$3000/ha, results may pay for this investment within a short time. (USBR)

W70-01218

Field 04—WATER QUANTITY MANAGEMENT AND CONTROL

Group 4A—Control of Water on the Surface

04. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control of Water on the Surface

FLOOD PLAIN INFORMATION, TROUT AND BIJOU CREEKS, SOUTH LAKE TAHOE, CALIFORNIA.

Corps of Engineers, Sacramento, Calif.

Corps Eng Flood Plain Rep, Jul 1969. 23 p, 7 fig, 11 plate, 8 tab.

Descriptors: *Floods, *Flood damage, *California, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood.

Identifiers: South Lake Tahoe (Calif), Standard project flood, Intermediate regional flood.

Flooding of Trout and Bijou Creeks, South Lake Tahoe, California, is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)

W70-00856

EFFECTS OF CULTIVATION AND GRASS ON SURFACE RUNOFF,

Agricultural Research Service, Coshocton, Ohio. Corn Belt Branch.

Frank J. Dragoun.

Water Resources Res, Vol 5, No 5, p 1078-1083, Oct 1969. 6 p, 2 fig, 3 tab, 8 ref.

Descriptors: Rainfall-runoff relationships, *Grasslands, *Cultivation, *Cultivated lands, *Land management, Watershed management, Soil conservation, Water conservation, Erosion control.

Identifiers: Cultivation effects (Runoff).

Results of research show the effect of drastic changes in land use on surface runoff from 4-acre watersheds near Hastings, Nebraska. Surface runoff was significantly reduced two years after converting marginal cultivated fields to perennial grass and was equivalent to runoff from native meadow after the third year. Conversely runoff increased greatly the first year after native meadow was placed in cultivation. The significance of these results is evident in the conversion of more than a million acres of marginal cropland to permanent vegetation in the Great Plains and in the proposed conversion of many more acres. (Knapp-USGS)

W70-00863

STATE HIGHWAYS.

III Ann Stat ch 121, secs 4-201, 4-201.9, 4-201.13 (Smith-Hurd 1960).

Descriptors: *Illinois, *Highways, *Bridges, *Administrative agencies, Legislation, Construction, Operation and maintenance, Navigable waters, Streams, United States, Contracts, Leases, Rivers, Transportation, Bridge construction.

Identifiers: *Ferries.

The Department of Public Works and Buildings shall have the power (1) to construct, purchase, lease or otherwise acquire, and (2) to operate without charge to the public, ferries over rivers and other waters upon any state highway, whether permanently or temporarily located, until such time as it is deemed feasible and desirable to construct, maintain, and operate bridges across any stream

between this state and any adjoining state where such bridge is necessary to connect the federal-aid highway network in this and such adjoining state and enter into agreements with adjoining states, persons, and the United States government in conjunction therewith. (Heckerling-Florida)

W70-00888

Proc, Int Hydrol Symp, Vol 1, Colo State Univ, p 283-289, Sept 1967. 7 p, 4 ref.

Descriptors: *Synthetic hydrology, *Simulation analysis, *River systems, *Water resources development, *Reservoir design, *Optimization, Hydrologic data, Irrigation practices, Multiple-purpose project, Gaging stations, Withdrawal.

Identifiers: Czechoslovakia.

Simulation studies of Czechoslovak rivers were made. The aim of the study was to choose the best combination and allocation of capacities of reservoirs to various uses in such a way as to generate the maximum net benefits. The design of the water resources system required the simulation of monthly flow records of some hydrologically related stations along with specific irrigation requirements. A multiunit multipurpose water resource system including five gaging stations, three reservoirs, a nonwithdrawal use and withdrawal consumption, was studied. Operating procedures were tested. The operation procedure with two stages of regulation proved best. As the data of the period under study (50 years) covered some critical sequences of low monthly flows and high specific irrigation requirements, the results of most studies with synthetic records gave higher net benefits than those using measured data. (Thiuri-Cornell)

W70-00900

A STOCHASTIC APPROACH TO THE DEVELOPMENT OF A REGULATION PLAN FOR THE GREAT LAKES,

Department of Energy, Mines and Resources, Ottawa (Ontario). Inland Waters Branch; and McGill Univ., Montreal (Quebec).

For primary bibliographic entry see Field 02H.

W70-00902

APPLICATION OF DYNAMIC PROGRAMMING TO THE CONTROL OF WATER RESOURCES SYSTEMS,

Stanford Research Inst., Menlo Park, Calif.

For primary bibliographic entry see Field 06A.

W70-00903

LOWER MISSISSIPPI RIVER BASIN DEVELOPMENT DISTRICT.

Miss Code Ann secs 5956-321 thru 5956-323, 5956-325 thru 5956-327, 5956-329, 5956-330 (Supp 1968).

Descriptors: *Mississippi, *Water conservation, *Water resources development, *Water allocation (Policy), Legislation, Legal aspects, Channels, Surface waters, Flood control, Water supply, Mississippi River Basin, Mississippi River, Federal government, Louisiana, Investigations, Feasibility studies, Cost-benefit analysis, Structures, Construction, Financing, Regulation, Planning, Eminent domain, Public utility districts, Parks, Pollution abatement, Water pollution control.

Identifiers: *Public policy, penalties (Civil).

It is declared as a matter of legislative determination that the waterways and surface waters of the state are among its basic resources; these resources have not been conserved to realize their full use; the utilization, development, conservation, and regulation of such waters are necessary for the purposes of flood control, pollution control, economic development, soil conservation, irrigation, navigation, and pollution abatement; these purposes are, as a matter of public policy, in the best public interest. The Lower Mississippi River Basin Development District is created with the power to: (1) develop in conjunction with appropriate state and federal agencies plans for public works of improvement appropriate to the purposes stated above; (2) acquire engineering surveys, feasibility studies and cost estimates relating to the construction of facilities for controlling, storing, using, and distributing the waters within the Lower Mississippi River Basin; (3) acquire, maintain, and use any property necessary for the purposes of the District; and (4)

CONDAMNATION BY CITIES, COUNTIES, AND DISTRICTS FOR FLOOD CONTROL OR DRAINAGE.

For primary bibliographic entry see Field 06E.

W70-00895

SIMULATION OF RUNOFF FOR DESIGN OF WATER RESOURCE SYSTEMS,

State Water Plan Development of Water Resources Management, Prague (Czechoslovakia).

Ing Zdenek Kos.

Control of Water on the Surface—Group 4A

finance its operation by specified means. Additional powers of the district include water resources allocation, construction of necessary facilities, water resources conservation, and regulation. (Keith-Florida)
W70-00912

FERRIES.

Ark Stat Ann secs 76-1701 thru 76-1730 (1958).

Descriptors: *Arkansas, *Navigable rivers, *Non-navigable waters, Legislation, Legal aspects, United States, Federal government, Lakes, Administrative agencies, Taxes, Safety, Permits, Regulation, Water rights, Riparian rights, Transportation.

Identifiers: *Public ferries, Tolls, Penalties (Criminal), Licensing.

All ferries over public navigable streams are deemed public ferries. Every person owning the land fronting on a public navigable stream is entitled to keep a public ferry over such stream. All lakes retained as public property by the United States are deemed public navigable streams for the purposes of this act. Specific provisions cover the licensing and taxation of ferries. The ferryman is charged with keeping the ferry in such condition as will insure the safety of his loads. Tolls are specifically regulated. Any private non-navigable stream may by court order be declared a ferry site in the public interest. (Keith-Florida)
W70-00913

COMMENT: EXTENDING THE APPLICATION OF THE LAW OF ACCRECTIONS.

Ohio Stat L J, Vol 23, No 4, p 771-773, Fall 1962. 3 p, 22 ref.

Descriptors: *Massachusetts, *Riparian rights, *Accretion (Legal aspects), *Riparian land, Ownership of beds, Beds under water, High water mark, Low water mark, Relative rights, Recreation, Navigation, Legal aspects, Competing uses, Easements, Land tenure, Land use, Beaches, Tidal waters, Judicial decisions.

Michaelson v Silver Beach Improvement Association, 342 Mass 251, 173 NE2d 273 (1961), involved a taking of riparian land by a municipality from private owners for the purpose of creating a public recreational beach. In Massachusetts riparian owners acquire title to adjacent land between the high and low water marks, subject to a public easement for navigation and free fishing. The doctrine of accretion is also operative in Massachusetts, and plaintiff landowners claimed that the artificial creation of the beach by the municipality was analogous to accretion and that ownership of the beach, therefore, inured to plaintiffs. The Supreme Court of Massachusetts agreed with this contention, holding that unless the municipality's project was connected with navigation or fishing, the private landowner had a right to the property or to compensation by the municipality. The author considers this result just, since the theory of riparian property is to encourage the development of private access to the sea. (Kelly-Florida)
W70-00921

CONSTITUTIONAL LAW--COMMERCE CLAUSE--WATER RIGHTS IN THE FLOW OF A NON-NAVIGABLE STREAM ARE PROPERTY RIGHTS,

Joseph H. Widmar.

U Pitt L Rev, Vol 21, No 3, p 548-551, Mar 1960. 4 p.

Descriptors: *Non-navigable waters, *Water rights, *Appropriation, *Compensation, Relative rights, Federal government, Judicial decisions, Preferences (Water rights), Federal jurisdiction, Legal aspects, Dams, Navigable waters, Tributaries,

ries, State governments, Streams, Water law, Reservation doctrine, Federal-state water rights conflicts, Jurisdiction, Riparian rights, United States, Riparian land.

Grand River Dam Authority v United States, 175 F Supp 153 (1959), is representative of the difficulties encountered by the courts in balancing the rights of individual landowners along non-navigable streams with the right of the federal government to control navigation. The instant decision held that an individual's rights in a non-navigable stream are property rights which may not be taken by the United States without compensation. Although the trend in recent years has been towards increased governmental immunity along navigable streams, the instant case indicates that the courts are reluctant to extend this immunity to non-navigable waters. It is settled that a private individual has no compensable property rights in the flow of a navigable stream, and there appears to be no justifiable reason for treating landowners along non-navigable streams differently. Upholding such a distinction would greatly increase the cost of and hinder federal water control projects. If the governmental immunity under the commerce clause extends to the taking of water rights on navigable streams, the same reasoning should allow takings on the non-navigable tributaries. (Marsee-Florida)
W70-00922

FEDERAL REGULATION OF WATERWAYS.

Rocky Mt L Rev, Vol 19, No 1, p 49-64, Dec 1946. 16 p, 22 ref.

Descriptors: *Federal jurisdiction, *Navigable waters, *Water rights, *Judicial decisions, Water resources development, Governments, Federal government, Federal-state water rights conflicts, State jurisdiction, Riparian rights, Relative rights, Watershed management, Prior appropriation, Flood control, Streams, Rivers, Water resources, Water law, Navigation, Navigable rivers, Rivers and Harbors Act, Tributaries, River systems, Legal aspects.

The federal government has asserted increasing control over streams and rivers through the Constitution's commerce clause. Congress has the power to regulate interstate commerce on navigable waterways. An early Supreme Court case held that rivers which are navigable in fact are navigable in law. Navigable in fact means susceptible of being used, in their ordinary condition, as highways of commerce. A later case expanded this test so that any stream which may at any time have borne any sort of navigation, in any form, may be termed a navigable waterway. And further, any stream or watershed which contributes to such navigable waterway is subject to federal regulation of commerce. Another Supreme Court decision held that whenever the profits of flood control exceed the costs, federal regulation of tributaries and watersheds is permitted, for watersheds are a key to flood control. The principal corollary effect of these cases is upon the water rights involved. Since water rights are not fifth amendment property and are subject to a dominant public interest in navigation, these rights on almost every stream are subject to destruction without just compensation. (Smith-Florida)
W70-00928

WATER AND WATER COURSES--SERVITUDES--ARTICLE 660, LOUISIANA CIVIL CODE OF 1870.

Tul L Rev, Vol 21, No 4, p 716-718, June 1947. 3 p.

Descriptors: *Louisiana, *Obstruction to flow, *Drainage, *Legislation, Judicial decisions, Remedies, Damages, Flooding, Crops, Flow augmentation, Drains, Surface waters, Surface drainage, Surface runoff, Upstream, Water law.

Identifiers: *Drainage servitude.

In the case of Brown v Blankenship, 28 So 2d 496 (La App 1946), defendant landowner allowed brush and other natural growth to accumulate within a natural drain leading from plaintiff's land. The obstruction caused drainage water to remain on plaintiff's land so as to seriously damage crops growing thereon. Plaintiff sued to have defendant remove the obstruction and place the drain in a condition which would permit water to flow uninterrupted. The trial court held for plaintiff, and the appellate court affirmed holding that under the Louisiana Code defendant was required to keep the natural drain open even though he had taken no affirmative action to obstruct it. Before this case, litigation over the servitude of drainage has involved affirmative actions which constituted a breach of the obligation created by the servitude. The instant case raises the legal question of whether the servitude of drainage imposes an obligation on the owner of the lower estate to take positive action to keep a drain clear of natural obstructions. Under the Civil Code, there is no duty to take any affirmative action to preserve the natural drainage. Therefore, it would seem that defendant owed the plaintiff no duty to take any affirmative action to prevent the natural obstruction. (Heckerling-Florida)
W70-00929

NAVIGABLE WATERS--ARTIFICIAL LAKE CONNECTED TO RIVER,

Donald Eugene Chaney.

Mo L Rev, Vol 24, No 3, p 392-393, June 1959. 2 p, 10 ref.

Descriptors: *Missouri, *Navigable waters, *Artificial watercourses, *Easements, Judicial decisions, Legal aspects, Mississippi River, Overflow, Banks, Dams, Fishing, Navigation, Federal government, Lakes, Relative rights.

Identifiers: *Public easements, Drainage ditches, Dedication.

Defendant created an artificial lake on his land and used it as a fishing resort. When the federal government constructed a dam on the Mississippi River, the water level of the artificial lake rose sufficiently so that it was possible to get a boat from the plaintiff's land across defendant's lake to the river. The plaintiff sued to force defendant to remove from his lake a pontoon bridge, and the trial court found for the defendant. The St. Louis Court of Appeals in Sneed v Weber, 307 SW2d 681 (St L Ct App 1957), held that defendant's lake was not navigable and not subject to a public easement of navigation. This was in line with the general rule that, subject to certain qualifications imposed by the commerce clause, an artificial body of water created by a private person on a site owned by him and not previously occupied by a body of navigable water, even though in fact usable for commerce, is not subject to rights of navigation by others unless the public acquires a right of navigation by dedication, which may be inferred from acquiescence in public use, or unless particular persons acquire an easement of navigation by prescription. (Keith-Florida)
W70-00937

DRAINAGE (CHICAGO SANITARY DISTRICT).

Ill Ann Stat ch 42, secs 362 thru 365, 368, 370, 372a, 381 (Smith-Hurd 1956).

Descriptors: *Illinois, *Lake Michigan, *Sanitary engineering, *Public health, Legislation, Regulation, Administration, Sewage, Sewage treatment, Locks, Dams, Canals, Navigation, Channels, Channel improvement, Municipalities, Taxes, Assessments.

The board of trustees of the sanitary district of Chicago may provide for the drainage of additional territory added to the district. The board may provide channels, drains, and ditches for carrying off sewage. The district's powers and jurisdiction over added territory shall be the same as that vested in it over the territory already included within the limits

Field 04—WATER QUANTITY MANAGEMENT AND CONTROL

Group 4A—Control of Water on the Surface

of said sanitary district. The district shall permit all watercraft navigating the Illinois and Michigan canal to navigate the water of all channels of the sanitary district without delay and without payment of tolls. The district has no power to levy and collect any special assessment or tax upon any part of the added territory. The district may construct all dams north of the upper basin of the Illinois and Michigan canal as may be deemed necessary. (Moulder-Florida)
W70-00940

DRAINAGE-SELECTION, QUALIFICATIONS, POWERS, AND DUTIES OF COMMISSIONERS AND OTHER OFFICERS.

III Ann Stat ch 42, secs 4-1 thru 4-39 (Smith-Hurd 1956), as amended, (Supp 1969).

Descriptors: *Illinois, *Drainage districts, *Drainage systems, *Administrative agencies, Legislation, Legal aspects, Drainage, Regulation, Compensation, Surveys, Construction, Maintenance, Drains, Levees, Eminent domain, Floods, Condemnation value, Right-of-way, Pumping plants, Repairing, Leases, Planning, Dredging, Easements, Assessments, Overflow, Loans, Financing, Wildlife management.

The elections of and qualifications for commissioners of drainage districts are provided for. The commissioners are under the supervision of the court, and many of their actions are subject to review by the court. The commissioners are empowered to: (1) use district funds for any lawful purpose; (2) do all acts necessary for the purpose of surveying, constructing, altering, enlarging, repairing, and maintaining any drain, levee, or other work of the district; (3) exercise the power of eminent domain to accomplish the foregoing purposes; and (4) enter into agreements with any state agency relative to the use and control of ditches, drains, levees, and drainage structures for the purpose of fish and game management. The commissioners are under a duty to keep the drains, levees, pumping plants, and other works of the district in operation and repair. The manner in which the commissioners are to finance the operations of the district is specified; in particular, the commissioners are empowered, subject to court approval, to levy assessments for specified purposes. The commissioners may build up and maintain an emergency fund to meet emergencies arising from flood, overflow, or acts of God. (Keith-Florida)
W70-00941

WATER-DRAINAGE AND LEVEE DISTRICTS.

Ark Stat Ann secs 21-101, 21-406, 21-407, 21-408 (1968).

Descriptors: *Obstruction to flow, *Arkansas, *Rivers, *Non-navigable waters, Salvage value, Navigation, Navigable rivers, Legislation, Drainage districts, Ditches, Drains, Levees, Legal aspects, Costs.

Identifiers: Penalties (Criminal).

The Cache River is declared a non-navigable river. It shall be unlawful for anyone to fell trees or timber in such a manner as to clog drains or ditches. Violation of this provision is a misdemeanor. Anyone who removes such obstruction has a cause of action for the costs of removal against the one causing the obstruction. (Darragh-Florida)
W70-00942

DRAINAGE DISTRICTS.

Miss Code Ann secs 4675, 4710, 4721, 4739, 4744 (1956).

Descriptors: *Mississippi, *Drainage districts, *Drainage programs, *Drainage engineering, Legislation, Eminent domain, Right-of-way, Taxes, Tax rate, Assessments, Condemnation, Utilities, Legal aspects, Channels, Ditches, Diversion structures, Levees, Overflow, Canals.

A procedure for creating drainage districts on petition of one-fourth of the landowners in the proposed district is authorized. Three temporary commissioners shall be appointed and shall have the power: (1) to select a competent engineer to survey the region and make suggestions; (2) borrow money to pay preliminary expenses; and (3) issue negotiable notes. All preliminary expenses of the drainage district shall be paid out of the proceeds of the first assessment levied under this article. Any landowner within the district may build ditches to drain his lands into the public ditches. The Board of Commissioners may condemn a right-of-way for such ditch. The Commissioners of the district may carry the ditches across, under, or through any highway, railroad, or utility lines. Districts created to control overflow and surplus water of rivers and their tributaries may additionally construct by passes to convey surplus waters by artificial means by a shorter route from tributaries to the main water course. This statute is not to be construed as changing the law with reference to the disposition and diversion of waters. (Schram-Florida)
W70-00952

SWAMP LAND DISTRICTS.

Miss Code Ann secs 4757 thru 4757-03 (1956).

Descriptors: *Mississippi, *Swamps, *Drainage districts, *Administrative agencies, Drainage, Channels, Legislation, Taxes, Tax rate, Assessments, Federal government, Administration, Government finance, Water districts, Channel improvement, Maintenance, Operation and maintenance, Legal aspects, Financing.

The swamp land districts previously organized by statute shall continue to operate. The adoption of this code shall not repeal such laws insofar as any of such districts are concerned. If there are no commissioners of such a swamp land district now in office, the county board of supervisors shall appoint three commissioners for a period of four years. The commissioners shall have control and management of all of the affairs of such swamp land district and shall have the power and authority: (1) to make improvements to and maintain existing drainage channels; (2) to contract and cooperate with any appropriate agency of the United States in so improving or maintaining any such channels; and (3) to expend the funds of such district. When recommended by the commissioners, the county board of supervisors may levy an annual tax on land in the district not to exceed twenty cents per acre in any one year. Said commissioners shall have full power and authority to do and perform all acts necessary and desirable in carrying out the purposes of this act. (Schram-Florida)
W70-00953

FLOOD CONTROL - DRAINAGE DISTRICTS.

Miss Code Ann secs 4763, 4765-4766-03 (1956).

Descriptors: *Mississippi, *Flood control, *Drainage districts, *Eminent domain, Condemnation, Easements, Right-of-way, Taxes, Tax rate, Assessments, Drainage engineering, Ditches, Drainage programs, Construction, Federal government, Legislation, Maintenance, Operation and maintenance, Maintenance costs, Administrative agencies, United States, Legal aspects.

The commissioners of any drainage district are authorized to give assurances to the federal government that all flood control works constructed by the United States will be maintained without expense to the United States. Said commissioners may accept for the district any conveyance of lands, such lands to be rented, leased, or conveyed for the benefit of the district. Such lands, when vested in the district, are subject to taxation as are other lands. The commissioners are authorized to fix and levy an annual ad valorem tax not exceeding two mills on real and personal property to defray maintenance of flood control works. The commissioners may also assure the United States that they will furnish rights-of-way for all levees and drainage

ditches constructed by the United States. The districts may acquire such rights-of-way by condemnation and eminent domain. The commissioners may levy an annual ad valorem tax not exceeding two mills for the purpose of defraying and expenses of acquiring said rights-of-way. (Schram-Florida)
W70-00954

TOMBIGBEE RIVER VALLEY WATER MANAGEMENT DISTRICT.

Miss Code Ann secs 5956-131, 5956-132, 5956-134, 5956-135, 5956-137 thru 5956-141, 5956-144, 5956-151 (Supp 1968).

Descriptors: *Mississippi, *Water resources development, *Water conservation, *Water utilization, Legislation, Legal aspects, Administrative agencies, Financing, Surface waters, Overflow, Natural resources, Regulation, Recreation, Public policy, Beneficial use, Impounded waters, Eminent domain, Taxes, Planning, Wildlife conservation, Contracts, Water supply, Flood control, Pollution abatement.

Identifiers: *Water management districts, Tombigbee River, Penalties (Criminal).

To conserve the state water resources for the realization of its full beneficial use especially with regard to the Tombigbee River Valley, the Tombigbee River Valley Water Management District is created and established. The method by which a county within the Valley may become a member of the District is provided. The powers of the District are explicitly enumerated and those powers include: public works planning to accomplish water resources development; the impoundment of overflow and surface waters for specified purposes; construction and maintenance of necessary facilities; the power of eminent domain; and the power to contract for specified purposes. The District may provide for public parks, recreation facilities, and wildlife conservation. The directors of the District are empowered to promulgate regulations, applicable within the District, regarding water pollution, the waste of water, and recreational privileges. All counties which are members of the District will pay two mills of ad valorem taxes due the state to the District. The District is empowered to issue bonds for specified purposes. The District may cooperate with other governmental agencies to accomplish the purposes of this Act. (Keith-Florida)
W70-00955

TOMBIGBEE RIVER VALLEY WATER MANAGEMENT DISTRICT.

Miss Code Ann secs 5956-131, 5956-132, 5956-134, 5956-135 (Supp 1968).

Descriptors: *Mississippi, *Water resources development, *Water conservation, *Water utilization, Legislation, Legal aspects, Surface waters, Watercourses (Legal), Overflow, Natural resources, Regulation, Flood control, Water supply, Pollution abatement, Irrigation, Navigation, Recreation, Tributaries, Public policy, Flood damage, Beneficial use, Impounded waters, Cities, Eminent domain, Administrative agencies, Planning.

Identifiers: *Water management districts, Tombigbee River.

It is declared as a matter of legislative determination that water resources in the state have not been conserved to realize their full beneficial use. The utilization, development, conservation, and regulation of such waters are necessary to insure: an adequate flood control program, sanitary water supply, fulfillment of irrigation needs, and improvement of navigation and pollution abatement. To carry out the foregoing purposes with regard to the Tombigbee River Valley, the Tombigbee River Valley Water Management District is authorized; the makeup of the board of directors of said District is provided for, and the manner in which counties may get into the District is provided for, and

Control of Water on the Surface—Group 4A

the manner in which counties may get into the District is set forth. When six counties have entered the District, it will be created as an agency of the state. The enumerated powers of the District include the power to: develop in conjunction with other government agencies plans for public works for the purposes of floodwater damage prevention or the conservation, development, navigation, utilization, and disposal of water; impound overflow water and the surface water of the Tombigbee River and its tributaries for the control, storage, preservation, or distribution of such waters; condemn land for the purposes of this act; overflow public lands within the District; and do any other acts necessary to accomplish the purposes of this act. (Keith-Florida)
W70-00956

TOMBIGBEE RIVER VALLEY WATER MANAGEMENT DISTRICT.

Miss Code Ann secs 5956-137, 5956-138 thru 5956-141, 5956-144, 5956-151 (Supp 1968).

Descriptors: *Mississippi, *Water resources development, *Financing, *Water utilization, Legislation, Legal aspects, Surface waters, Watercourses (Legal), Natural resources, Regulation, Water supply, Recreation, Reservoirs, Wildlife conservation, Easements, Fishing, Boating, Permits, Taxes, Administrative agencies.

Identifiers: *Water management districts, *Tombigbee River, Public parks, Penalties (Criminal).

The Tombigbee River Valley Water Management District is authorized to provide for public parks, recreation facilities, and wildlife preservation. It may acquire land within the project area for such purposes. The District's Board of Directors is empowered to promulgate all reasonable regulations to secure, maintain, and preserve the sanitary condition of all water flowing into any District reservoir, to prevent the waste or unauthorized use of water, and to regulate all recreational and business privileges exercised within the District. The District is empowered to obtain an appropriation permit from the State Board of Water Commissioners. So long as the District has obligations outstanding, each member county will pay to the District two mills of all ad valorem taxes due by the county to the state and one-half mill on all of the county's taxable property within the District. An additional levy of two mills may be made by the counties for the District in specified circumstances. The District's board of directors is empowered to borrow money or issue District bonds for the purpose of financing the District's operations. The District is empowered to act jointly with other political subdivisions to implement the purposes of this act. (Keith-Florida)
W70-00957

BIG BLACK RIVER BASIN DISTRICT.

Miss Code Ann secs 5956-221 thru 5956-223, 5956-225 thru 5956-228, 5956-230, 5956-231, 5956-234 (Supp 1968).

Descriptors: *Mississippi, *River basins, *Administrative agencies, *Water resources development, Rivers, Taxes, Tax rates, Leadership, Legislation, State governments, Federal government, Overflow, Dams, Erosion control, Floodwater, Flood protection, Flooding, Flood control, Recreation facilities, Parks, Appropriation, Eminent domain, Forests, Soil conservation, Tributaries.
Identifiers: *River basin districts.

To conserve, store, and regulate the waters of the Big Black River and its tributaries and their overflow waters, this act authorized the organization of the Big Black River Basin District. The Act provides for the selection and composition of a board of directors for such district and establishes procedure for the District's creation. Counties becoming members of the District are required to make annual payments thereto from funds raised

by special tax levy. Numerous powers are given the District, including the power: (1) to impound and appropriate overflow and surface waters of the Big Black River and its tributaries; (2) to forest and reforest; (3) to prevent soil erosion; (4) to acquire lands by condemnation; (5) to require relocation of roads, railroads, power lines, and other named facilities; (6) to inundate public lands; (7) to establish and operate necessary facilities; and (8) to establish public parks and recreation facilities. The Act further gives the board of directors power to promulgate regulations for the District and sets forth penalties for violations thereof. The District may also borrow money and issue bonds. (Marsee-Florida)
W70-00961

BIG BLACK RIVER BASIN DISTRICT.

Miss Code Ann secs 5956-221 thru 5956-223, 5956-225, 5956-226, (Supp 1968).

Descriptors: *Mississippi, *River basins, *Administrative agencies, *Water resources development, Soil conservation, Rivers, Taxes, Tax rates, Financing, Leadership, Legislation, State governments, Overflow, Erosion control, Dams, Floodwater, Flood protection, Flooding, Flood control, Recreation facilities, Parks, Forests, Forestry, Tributaries. Identifiers: *River basin districts.

The purposes of this Act are to conserve, store, and regulate the waters and overflow waters of the Big Black River and its tributaries for: (1) commercial, municipal, industrial, agricultural, and manufacturing purposes; (2) recreational purposes; (3) flood control; (4) timber development and irrigation; (5) navigation; (6) soil conservation; and (7) pollution abatement. Toward these purposes the Big Black River Basin District is authorized to be organized. All powers of the District shall be exercised by a board of directors to be selected and composed as herein provided. The District shall be created by the procedures set forth in this Act, after which creation any county may, through its board of supervisors, become a member. Counties becoming members of the District are required to make annual payment thereto from funds raised by special tax levy. (Marsee-Florida)
W70-00962

BIG BLACK RIVER BASIN DISTRICT.

Miss Code Ann secs 5956-227 thru 5956-228, 5956-230, 5956-231, 5956-234 (Supp 1968).

Descriptors: *Mississippi, *River basins, *Administrative agencies, *Water resources development, Rivers, Financing, Contracts, Legislation, State governments, Federal government, Overflow, Dams, Erosion control, Floodwater, Flood protection, Flood control, Recreation facilities, Parks, Appropriation, Eminent domain, Forests, Soil conservation, Tributaries, Grants.
Identifiers: *River basin districts.

The Big Black River Basin District is empowered to: (1) develop, in conjunction with federal and state agencies, plans for the conservation, development, storage, and regulation of soil and waters within the Pearl River Basin; (2) develop waters for navigation and prevention of flood damage; (3) acquire property by purchase, lease, or gift; (4) obtain grants and loans from the United States; (5) contract; (6) make surveys relating to the construction of dams and reservoirs; (7) impound for beneficial use the surface water of the Big Black River and its tributaries; (8) forest and reforest, and prevent erosion and flood within the District; (9) store and preserve waters for irrigation and prevention of water pollution; (10) acquire property interests by eminent domain; (11) require the relocation of roads and highways, railroad lines, telephone and telegraph lines, properties, electric power lines, gas pipelines, and mains and facilities; (12) inundate public lands; (13) issue bonds; (14) fix and collect charges for services, facilities, or

commodities furnished by the District; (15) lease or sell property; (16) cooperate with other governmental agencies; and (17) establish public parks and recreation facilities. (Marsee-Florida)
W70-00963

LOWER YAZOO RIVER BASIN DISTRICT.

Miss Code Ann secs 5956-351 thru 5956-353, 5956-355 thru 5956-358, 5956-360, 5956-361, 5956-369 (Supp 1968).

Descriptors: *Mississippi, *River basin development, *Water districts, *River basin commissions, Legislation, Taxes, Operating costs, Tax rate, Assessments, Surface waters, Overflow, Water conservation, Fish conservation, Wildlife conservation, Optimum development plans, Water pollution, Dams, Canals, Reservoirs, Condemnation, Easements, Construction, Right-of-way, Financing, Water pollution control, Flood control.

Authority is given to organize the Lower Yazoo River Basin District to utilize, develop, conserve, and regulate the waters of that river. Provisions are made for the appointment of a Board of Directors who shall exercise all powers of the District. The creation of the District is dependent upon its ability to get at least three counties to join. Provisions describing the procedure for membership are detailed. Once the District is established, a tax levy of one-half mill is authorized within each member county to support the projects of the District. The District is empowered to: (1) make bylaws and regulations; (2) acquire land; (3) make feasibility studies; (4) impound and appropriate water from the river for beneficial use; (5) construct needed facilities; and (6) acquire by condemnation any easement or property needed. A number of qualifications to these powers are included. Additionally, the District is authorized to provide for the preservation of fish and wildlife, secure sanitary water conditions, and prevent pollution. The power to borrow money and issue bonds is granted. (Schram-Florida)
W70-00964

LOWER YAZOO RIVER BASIN DISTRICT.

Miss Code Ann secs 5956-351 thru 5956-353, 5956-355, 5956-356 (Supp 1968).

Descriptors: *Mississippi, *River basins, *River basin development, *River basin commissions, Water districts, Legislation, Taxes, Operating costs, Tax rate, Payment, Income, Assessments, State governments, Surface waters, Surface runoff, Overflow, Water conservation, Administration, Optimum development plans, Water law, Flood control, Financing.

Provisions are made for the organization of the lower Yazoo River Basin District to utilize, develop, conserve, and regulate the overflow and surface waters of the Lower Yazoo River. A Board of Directors is authorized and all powers of the District are to be exercised by them. Provisions for appointment of members, their compensation, and election of officers are made. If any county desires to become a member of the District, it must provide for an election to do so and approve a special ad valorem tax of one-half mill on all taxable property in the county. When three counties have become members of the District in the manner provided, such District will then become created as an agency of the State. Each county which becomes a member of the District shall pay its pro rata share of the budgetary requirements of the District. Such share shall not exceed the avails of the levy of one-half mill on all taxable property in the county. Additional provisions include the methods of payment and authorization for the taxing power. (Schram-Florida)
W70-00965

LOWER YAZOO RIVER BASIN DISTRICT.

Miss Code Ann secs 5956-357, 5956-358, 5956-360, 5956-361, 5956-369 (Supp 1968).

Field 04—WATER QUANTITY MANAGEMENT AND CONTROL

Group 4A—Control of Water on the Surface

Descriptors: *Mississippi, *River basin commissions, *Water districts, *River basin development, Legislation, Condemnation, Navigation, Construction, Easements, Right-of-way, Wildlife conservation, Fish conservation, Water pollution, Water conservation, Federal government, Dams, Canals, Reservoirs, Water pollution control, Recreation facilities, Programs.

The Lower Yazoo River Basin District, through its Board of Directors, is empowered to establish plans for public works of improvement for the development of waters in the district for navigation, industry, commerce, and shipping. Additional powers include the right: (1) to make by laws and regulations; (2) to acquire land; (3) to make feasibility studies; and (4) to exercise any other rights inherent to a corporate body. When the district has developed plans for a project, additional powers shall come into being in relation to such project. These include the right: (1) to impound and appropriate for beneficial use water of the river; (2) to construct all facilities deemed necessary; and (3) to acquire by condemnation any needed property. A series of limitations and qualifications to these powers are included. The district is authorized to provide for the preservation of fish and wildlife and to acquire land otherwise than by condemnation for such purposes. The directors are empowered to promulgate regulations to secure sanitary water conditions, prevent waste, and prevent pollution. The board may borrow money and issue bonds and notes to carry out the duties of this act. (Schram-Florida)
W70-00966

WESTPHAL V SCHMALZ (UNAUTHORIZED USE OF DRAINAGE SYSTEM).

169 NW2d 401-403 (Minn 1969).

Descriptors: *Drainage, *Minnesota, *Watersheds (Basins), *Drainage systems, Excess water (Soils), Judicial decisions, Tile drainage, Ditches, Drainage engineering, Drainage water, Land management, Watersheds (Divides), Flood control, Riddance (Legal aspects), Drains, Subsurface drains, Flood damage, Floods, Overflow, Agricultural watersheds, Damages, Assessments, Benefits, Project benefits, Relative rights, Legislation, Legal aspects.

Defendant landowner drained part of his tract into a judicial ditch system serving another part of his tract and plaintiff's tract. The land drained was not within the watershed served by the system and therefore was not assessed for benefits. Defendant cut across the watershed line with a tile drain to connect with an existing outlet in a part of his land within the watershed. Due to the increased pressure and volume of water in the extension serving plaintiff's land, a portion of his tract was flooded after a heavy rainstorm causing flood damage to his crops. Plaintiff was granted a permanent injunction and damages. The applicable statute required a ditch system be used only when the land was assessed for benefits in the original judicial proceedings which established the ditch or when express authority was secured from the proper court or agency. This portion of defendant's tract was not within the watershed, and drainage of the land was not authorized under the statute. (Doublerley-Florida)
W70-00971

CONDEMNATION BY CITIES AND COUNTIES TO PROVIDE WATERSHEDS OR BEDS FOR WATER PIPES.

Va Code Ann sec 25-232 (1969).

Descriptors: *Virginia, *Condemnation, *Local governments, *Watersheds (Divides), Large watersheds, Small watersheds, Land use, Land tenure, Control, Eminent domain, Right-of-way, Easements, State jurisdiction, Costs, Pipes, Legislation, Legal aspects.

The governing body of any city or town may acquire by condemnation such lands or rights-of-

way as may be necessary for providing watersheds for the use of such city or town and may acquire the necessary lands or rights for laying water pipes from such watersheds. The power of condemnation may be used where terms of purchase of the land cannot be agreed upon due to the incapacity of the owner or due to an inability to find the owner within this state. (Kelly-Florida)
W70-00973

EFFECT OF CHANGES OF STREAMFLOW REGIMEN ON RESERVOIR YIELD,

State Univ. of New York, Syracuse. Water Resources Center.

Richard H. Hawkins.

Water Resources Res, Vol 5, No 5, p 1115-1119, Oct 1969. 5 p, 4 fig, 1 tab, 8 ref.

Descriptors: *Reservoir yield, *Streamflow, *Reservoir operation, Reservoir storage, Water management (Applied), Water yield, Regimen, Systems analysis, Synthetic hydrology, Hydrographs.

Identifiers: Streamflow regimen changes.

A presumptive approach was used to gain insight into the question: How do alterations of streamflow characteristics affect downstream objectives. The special case of flows changed in timing and volume from management on the tributary watershed in tandem combination with a downstream reservoir was considered. Change in mean yield of the reservoir was taken as an index of utility of the streamflow changes. Uniform increases of streamflow of 5% and 15% and a half month delay in the annual hydrograph were assumed either singly or in combination, storage yield computations made, and differences in yields determined. Not all extra streamflow was found to be useful although the increases gained utility with increasing storage availability. A timing delay was most important with smaller storage availability and then only to a limited degree. Flow increases combined with a timing delay produced results that were approximately simple additions to the two individual effects. (Kapp-USGS)
W70-01001

A WATER DISTRIBUTION SYSTEM FOR COLD REGIONS, The Single Main Recirculating Method. An Historical Review, Field Evaluation, and Suggested Design procedures,

Alaska Univ., College. Inst. of Water Resources.

R. Sage Murphy, and Charles W. Hartman.

Available from the Clearinghouse as PB-187 685, for \$3.00 in paper copy, \$0.65 in microfiche. Project Completion Report, Institute of Water Resources Report No IWR-8, March 1969. 78 p, 2 tab, 19 fig, 69 ref. OWRR Proj A-018-ALAS.

Descriptors: *Distribution systems, *Pipelines, Water distribution, Arctic, Cold weather construction.

Identifiers: *Arctic water distribution system.

The report describes the single-main recirculating water distribution system used in arctic and subarctic communities to prevent water main freezing. An historical review, data from a prototype installation, and recommended design procedures are included for Far North facilities. The field data was obtained at Unalakleet, Alaska, a community on Norton Sound, an arm of the Bering Sea. Over a year of continuous data were obtained starting at the time the installation was constructed in 1965. The described facility is one of three presently in existence.
W70-01088

BASIC WATER USE DOCTRINES AND STATE WATER CONTROL AGENCIES.

Am Water Wks Ass'n J, Vol 42, No 8, p 755-760, Aug 1950. 6 p, 1 ref.

Descriptors: *Water policy, *Administrative agencies, *Groundwater, *Surface waters, Water law, State governments, Legal aspects, Interstate compacts, Riparian rights, Appropriation, Reasonable use, Colorado River Compact, Water rights, Water resources, Legislation, Water pollution, Pollution abatement.

Basic water law for both surface and ground water is discussed including the riparian doctrine, appropriation doctrine, common law rule, rule of reasonable use, and appropriation doctrine. Also discussed are the state water control agencies which approve water uses. The functions of these agencies are divided into the following categories: (1) surface water; (2) ground water; (3) dams and diversion works; (4) water quality and treatment (public supplies); (5) water quality and treatment (industrial drinking water); (6) stream pollution control; (7) sewage disposal (technical); and (8) industrial waste disposal (technical). Statistical information is presented concerning states having agencies exercising control over surface or groundwater. Briefly examined are several interstate compacts and agreements for the control and development of water resources. (Gabrielson-Florida)
W70-01131

APPROPRIATION WATER LAW ELEMENTS IN RIPARIAN DOCTRINE STATES,

For primary bibliographic entry see Field 06E.

W70-01134

WISCONSIN LAW OF WATERS,

Adolf Kanneberg.

Wis L Rev, Vol 1946, No 2, p 345-393, Mar 1946. 4 p, 151 ref.

Descriptors: *Wisconsin, *Water management (Applied), *Navigable waters, *Administrative agencies, Navigation, Saw log test, Floatable streams, Riparian rights, Dams, Non-navigable waters, Ownership of beds, Federal government, Navigable rivers, Water levels, Water control, Water law, Administration, Permits, Regulation, Legal aspects.

The determination and regulation of 'navigable waters' differs widely within the federal system. Federal definitions make navigable waters public highways, but fail to designate what waters are navigable. Wisconsin adopted the riparian doctrine of water law but has depended on case law and statutes in developing a definition of navigable waters, concluding that streams navigable in fact are public and that those non-navigable in fact for any reason are private property. Although beds under navigable streams may be owned by the respective riparians, those rights of ownership are subject to a public right of navigation. Wisconsin has vested control over navigable waters in the Public Service Commission with power to: (1) regulate the flow and level of water in streams; (2) issue permits to construct dams on navigable streams; (3) issue permits for diversion of surplus water from one watershed to another; (4) authorize bridges over navigable streams; (5) abate unlawful obstructions in navigable waters; (6) contract for the removal of sand, gravel, and marl from beds of navigable lakes; (7) supervise water control for Milldam Act dams; (8) regulate dams on non-navigable streams. (McDonough-Florida)
W70-01138

THE NAVIGATION SERVITUDE AND JUST COMPENSATION: STRUGGLE FOR A DOCTRINE,

Richard W. Bartke.

Ore L Rev, Vol 48, No 1, p 1-24, Dec 1968.

Descriptors: *Federal jurisdiction, *Condemnation, *Compensation, *Condemnation value, Proprietary power, Riparian rights, Water rights, Easements, Admiralty, Benefits, Water resources, Water resources development, Water, Water law, Navigable waters, Navigable rivers, Legislation,

Control of Water on the Surface—Group 4A

Water policy, Planning, Eminent domain, Judicial decisions.

The national sovereignty over navigable waters, called the 'navigation servitude,' is similar to an easement and is derived from the Constitution's commerce clause and grant of admiralty jurisdiction. These provisions entitle the federal government to the use and benefit of the bed, banks, and water of any navigable watercourse and have conferred upon the federal government a proprietary interest in the navigable waters of the nation. The problem exists as to what compensation is required by the fifth amendment to be paid for the taking of 'fast lands,' or lands just above the ordinary high water mark. The sovereign does not have to pay for what it owns. So where condemned land has added value because of a possible water-power site, no additional compensation is paid. The water power is subject to the navigation servitude, so no private party has an interest therein. Where partial flooding of land would increase the value of the remainder of the land, this increase can be deducted from the compensation for the flooded portion. But if the remainder were also flooded later, only the original value would be awarded. Various other types of awards have also confused and clouded the law. (Smith-Florida)
W70-01144

THE NAVIGATION SERVITUDE AND JUST COMPENSATION: STRUGGLE FOR A DOCTRINE,
Richard W. Bartke.
Ore L Rev, vol 48, no 1, p 24-44, Dec 1968.

Descriptors: *Federal jurisdiction, *Condemnation, *Federal Power Act, *Compensation, Easements, Planning, Condemnation value, Proprietary power, Riparian rights, Water rights, Navigable waters, Water policy, Navigable rivers, Water resources, Benefits, Water, Water law, Judicial decisions, Legislation, Admiralty, Water resources development.

Certain state governments, local governmental bodies, or private parties may invoke the navigation servitude through the federal eminent domain power as a licensee under the Federal Power Act. A licensee likewise will have to pay just compensation for property taken, but not for interests attributable to the navigation servitude. Under section 21 of the Federal Power Act, Congress donated parts of the public domain for the purpose of power development. If any charge is made for these donations, such charge should be reflected in either payments to the federal treasury or lower power rates to consumers. Section 21 should be construed as putting a Federal Power Commission licensee in the same position as the United States, with the same power of eminent domain. The use of water has been rapidly increasing. Therefore, it is becoming more important that planning be comprehensive for an entire basin. In this planning the navigation servitude may be of crucial importance. Once the courts admit that the federal navigation servitude is proprietary in nature, many of the problems involving water rights will be resolved. (Smith-Florida)
W70-01145

STOUDER V DASHNER (DOMINANT VERSUS SERVIENT LAND RIGHTS RELATING TO DRAINAGE OF SURFACE WATERS).
49 NW2d 859-866 (Iowa 1951).

Descriptors: *Iowa, *Surface runoff, *Drainage water, *Obstruction to flow, Surface drainage, Channels, Water spreading, Overland flow, Floods, Drainage, Runoff, Surface-groundwater relationships, Surface waters, Percolating water, Subsurface runoff, Relative rights, Remedies, Legal aspects, Judicial decisions.

Plaintiff upper landowner brought action against defendant lower landowner and others to enjoin them from maintaining obstructions that prevented

surface flood waters from draining from plaintiff's land onto defendant's land. Defendant filed a counterclaim for damages and prayed for an injunction for removal of a concrete tube located under a railroad embankment. The original rule in Iowa concerning drainage of surface waters has been modified in the interest of agriculture to the extent that the owner of the higher land may drain his land into a natural watercourse without liability to a lower proprietor for resulting damages, even if the effect is to throw the surface water in somewhat increased volume on the servient estate. A definite channel is not essential to definition of a watercourse. A dominant proprietor may, through use of a ditch, cause water to flow in its natural direction instead of over the surface or by percolation where no new watershed is tapped and where no addition to the former volume is caused by said ditch outside of what formerly reached the same point on the servient tract over a wider surface. Based on this rule the trial court held for the plaintiff and was affirmed by the Supreme Court. (Moulder-Florida)
W70-01146

ROCKLAND COUNTY ANTI-RESERVOIR ASS'N V DURYEA (PREVENTION OF RESERVOIR CONSTRUCTION).
282 App Div 457, 123 NYS2d 445-452 (Sup Ct 1953).

Descriptors: *New York, *Reservoirs, *Reservoir construction, *Water works, Legislation, Regulation, Reservoir yield, Usable storage, Reservoir sites, New Jersey, Safe yield, Water distribution (Applied), Water supply, Water yield improvement, Judicial decisions, Reservoir operation, Reservoir storage, Relative rights.

Spring Valley Water Works, a wholly owned subsidiary of Hackensack Water Company, supplies water to communities in Rockland County. Spring Valley Water Works determined that due to the expanding population and industrial water requirements of the area, more water was needed to meet the area's needs. Following their petition, the Company received permission to construct a reservoir from the Water Power and Control Commission. This decision was challenged, with the principal contention being that the reservoir would have greater capacity than required and that the project was for the primary benefit of the water company. This contention was rejected by the Commission, which stated that an additional source of water was essential to assure Spring Valley an adequate supply for present and future needs. The benefit to the Company was substantial but a necessary, incidental effect of the project. In a review of this decision, the court found that the Commission's findings upon the subject of the project's 'public necessity' were adequate. The Commission did not have to make findings upon the question of comparative well and reservoir costs or the effect of the reservoir on the consumer water rates. Section 396 of the conservation law was found to be constitutional. (Moulder-Florida)
W70-01147

JURISDICTION OF COUNTY DRAINAGE BOARDS.

Ind Ann Stat secs 27-2201 thru 27-2206 (Supp 1968).

Descriptors: *Indiana, *Drainage systems, *Administrative agencies, *Jurisdiction, Drains, Drainage districts, Local governments, Cities, Assessments, Water districts, Riparian rights, Flood control, Maintenance, Benefits, Legislation, Legal aspects.

Legal drains are under the jurisdiction of the county drainage board in each county. Legal drains located within a conservancy district are not subject to this act unless they flow directly or indirectly into any legal drain subject to this act. In such case, the board will assess the lands within the conservancy district to the extent benefited. Legal drains that are part of a flood control project are

not within the jurisdiction of this act. Private and mutual drains, and city or unincorporated town drains are not subject to this act, but the lands drained may be assessed for improvements to a legal drain if such lands are also drained by a legal drain. Any or all owners of lands affected by a mutual drain may request the board to assume jurisdiction over the drain and declare it a legal drain. Upon request, the board may determine if drainage maintenance and repair districts or associations formed to maintain and repair drains are no longer active. On finding that such districts or associations are no longer active, the board may declare the drains to be legal drains and assume jurisdiction over them. (McDonough-Florida)
W70-01150

FLOOD CONTROL.

Miss Code Ann secs 4767, 4767.3, 4767.7, 4768 (1956), as amended, (Supp 1968).

Descriptors: *Mississippi, *Flood control, *Channel improvement, *Local governments, Cutoffs, Dams, Levees, Eminent domain, Taxes, Tax rate, Assessments, Condemnation, Easements, Right-of-way, Construction, Legislation, Mississippi River, Federal government, National parks, National memorials, Drainage, Legal aspects, Political aspects, Leases.

The Board of Supervisors of any county where the United States has authorized flood control improvements, including channel clearing, cut-offs, levees, and dams is authorized, in relation to such project, to assure the federal government that it will: (1) provide all necessary lands, easements, and rights-of-way; (2) hold the United States free from any damages due to construction; and (3) maintain and operate the works after completion. Additional powers of said counties include the right to: (1) levy and assess taxes; (2) exercise eminent domain; (3) accept conveyances of land; and (4) accept agreements from benefitted landowners to save the county harmless on account of said assurances given by the county. The board of supervisors of any county on the Mississippi in which a national park or cemetery is located may additionally levy a county-wide tax to supplement the construction and maintenance of the project. When the needed land is outside the county, the county is empowered to contribute to the cost of acquiring such land. All moneys paid to the state by the federal government for leases of flood control lands shall be apportioned to the counties in which such lands are located. (Schram-Florida)
W70-01153

SILVER BLUE LAKES APARTMENTS V SILVER BLUE LAKE HOME OWNERS ASS'N INC (UNREASONABLE USE OF ARTIFICIAL WATERBODY).
225 So2d 557-561 (3 DCA Fla 1969).

Descriptors: *Judicial decisions, *Legal aspects, *Florida, *Lakes, Riparian rights, Ownership of beds, Usurpary right, Relative rights, Remedies, Riparian land, Surface waters.

Identifiers: *Man-made lakes, Injunctions (Prohibitory).

The owners of land underlying a man-made lake sought to enjoin an allegedly unreasonable use of the surface of the lake by tenants of an apartment complex bordering on the lake. The trial court issued the injunction to permanently enjoin the tenants from using the lake and restricting use to owners of the underlying land. The corporate owner of the apartments appealed, alleging that said injunction violated his constitutional rights. The district court of appeal affirmed saying that no rights of the owner were disturbed as he could still use the lake as an owner. The tenants, however, were not owners of underlying land. Therefore, they could be completely enjoined from using the lake because their use was unreasonable and made it impossible for the actual owners to exercise their right to use the lake. The corporate owner would

Field 04—WATER QUANTITY MANAGEMENT AND CONTROL

Group 4A—Control of Water on the Surface

not be permitted to control the use of this man-made lake by multiplying its right of use by the number of tenants claiming under the corporation. (Darragh-Florida)
W70-01154

SURFACE RUNOFF AND FLOODWATER DIVERSION.

Va Code Ann secs 62.1-105, 62.1-106 (1968).

Descriptors: *Virginia, *Riparian rights, *Surface runoff, *Impounded water, Diversion, Water permits, Floodwater, Water levels, Prior appropriation, Priorities, Administration, Diversion structures, Water control, Water injury, Water law, Water rights, Water storage, Average flow, Damages, Legislation, Impoundments, Legal aspects.

Identifiers: Floodwater diversion.

A landowner may capture surface runoff waters on his land provided the capture does no damage to others. Upon approval, riparian owners may capture or impound water in watercourses which is over and above the average flow of the stream if: (1) the capture or storage will not damage others; (2) the riparian owner owns the land on which the water will be stored; (3) the riparian owner bears all costs of impounding the water; (4) a registered civil or agricultural engineer approves of the construction of the impounding facilities; and (5) the capture of water will not decrease the average flow in the watercourse. Upstream riparian owners have priority to the right to store floodwaters. (McDonough-Florida)

W70-01177

MILLS, DAMS, AND CERTAIN OTHER WORKS ON WATERCOURSES.

Va Code Ann secs 62.1-116, 62.1-119, 62.1-124 (1968).

Descriptors: *Virginia, *Mills, Mill dams, *Canals, Legislation, Public benefits, Public health, Dams, Dam construction, Barriers, Diversion structures, Fish barriers, Overflow, Navigation, Compensation, Riparian rights, Water law, Watercourses (Legal), Canal construction, Administrative agencies, Water works, Relative rights.

Identifiers: *Obstructions to navigation.

A person owning a water mill useful to the public and desiring leave to erect a dam across or in the bordering watercourse, or to cut or enlarge a canal through lands above or below, or to raise a dam, or to construct a work on or through the lands of another to confine the watercourse, may apply to the circuit court of the county wherein such mill is located for such permission. Commissioners, appointed to decide such issue, must inquire whether any lands will be overflowed, navigation and the passage of fish will be obstructed, or the health of the neighbors will be annoyed by the stagnation of the waters or otherwise. They must also circumscribe the lands necessary for the canal, dam, or work not being more than one acre for a dam, nor more than one hundred feet in width for a canal, and must ascertain a just compensation. Any lands which will be adversely affected shall likewise be examined and compensation ascertained. These results must be set forth in a report. No person may by means of any such leave draw the water from any millpond of another or do anything in conflict with any vested right in any waterworks erected on such watercourse. (Schram-Florida)

W70-01178

IMPROVEMENT OF NAVIGABILITY OF STREAMS.

Va Code Ann secs 62.1-155 thru 62.1-158 (1968).

Descriptors: *Virginia, *Navigable rivers, *Navigation, *Channel improvement, Legislation, Easements, Right-of-way, Legal aspects, Permits, Pipelines, Transportation, Drainage systems, Bridges, Oysters, Shellfish, Clams, Local governments, Federal government, Water resources development, Utilities, River basin development, Dredging.

All cities situated on navigable streams may cooperate with the United States in the deepening, widening, and straightening of the channels thereof to improve navigability and in making provision for turning basins at terminals and mooring areas thereon. Such cities may assure the United States that they will: (1) furnish lands, easements, and rights-of-way and spoil or dredged material disposal areas; (2) furnish permits for ingress and egress to highways, construction of pipeline trestles across oyster and clamping grounds, and laying dredge pipelines across adjacent lands; (3) hold the United States free from damages; (4) relocate roads, bridges, waterfront structures, sewerage, water supply, and other utility facilities; (5) construct, maintain, expand, and operate terminal facilities; and (6) contribute funds for mooring areas adjacent to river terminals of such cities when necessary because of expansion of such terminal facilities. Such cities have the power to irrevocably bind themselves to do anything necessary to execute the above assurances. Claims for damages to oyster and clamping grounds may be asserted in the courts having jurisdiction in the county or city in which such damages occur. (Schram-Florida)

DUTIES OF DIRECTOR OF PUBLIC WORKS.

R I Gen Laws Ann secs 46-1-1, 46-1-2 (1956)

Descriptors: *Rhode Island, *Administrative agencies, *Harbors, *Supervisory control (Power), Tidal waters, Utilities, Public rights, Surveys, Navigation, State governments, State jurisdiction, Legislation, Water law, Legal aspects, Regulation, Administration.

Identifiers: Obstructions.

The Director of Public Works has control and supervisory power over all harbors and tidewaters in the state. The Director may order the removal of unauthorized obstructions and encroachments in harbors and tidewaters and may survey harbors and public waters to protect state interests. (McDonough-Florida)

W70-01182

CONSTRUCTION OF PORT FACILITIES.

R I Gen Laws Ann secs 46-5-1 thru 46-5-16 (1956), as amended, (Supp 1968).

Descriptors: *Rhode Island, *Harbors, *Port authorities, *Coastal engineering, Coastal structures, Navigation, Transportation, Eminent domain, Land tenure, Riparian rights, Piers, Channelling, Channels, Bulkheads, Landfills, Rates, Public benefits, Administrative agencies, State governments, Public lands, Legal aspects, Legislation, Leases, Docks, Basins, Condemnation.

The Department of Natural Resources may acquire by purchase, lease, or condemnation any real property, tide-flowed lands, plats, terms, easements, privileges, foreshore, riparian rights, littoral rights, and uplands as are necessary for public use. Title to such land shall vest in the state. Procedures are set forth herein for the taking of such lands. The Department may utilize such land for the construction of wharves, piers, bulkheads, slips, docks, basins, channels, and other port facilities, and may establish rates for the wharfage, cranage, and docking of all vessels admitted thereto. The Department may also: (1) control and manage a portion of such facilities for public use; (2) lease the facilities; (3) establish regulations and penalties for the care of the acquired property; and (4) dispose of lands no longer needed. The administration of the division of fish and game in the Department of Agriculture and Conservation may expend the

funds herein appropriated to establish and maintain yacht and boat moorings. Such moorings shall be available to the public without charge. (Marsee-Florida)

W70-01183

OBSTRUCTIONS TO NAVIGATION.

R I Gen Laws Ann secs 46-6-1 thru 46-6-16 (1956).

Descriptors: *Rhode Island, *Navigation, *Administrative agencies, *Regulation, Landfills, Tidal waters, Abatement, Cost allocation, Costs, Cost repayment, Cost transfer, Bays, Rivers, Boats, Piers, Bridges, Bridge construction, Oysters, Ships, Legislation, Federal government, State governments, Riparian rights.

Identifiers: *Shipwrecks, *Obstruction to navigation.

The Director of Public Works regulates the depositing of dirt and other substances into public tidewaters, and plans for the filling of tide flats or the construction of wharves, piers, bridges, or other structures over public tidewaters must be approved by the Department of Public Works. Unauthorized encroachments on tidewater constitute a public nuisance and may be abated. Special provisions are made for the protection from obstruction of certain specified watercourses. The Director of Public Works shall remove or have removed wrecked, sunken, or abandoned vessels and other obstructions from state tidewaters. The cost of such removal is distributed as herein provided. It is the duty of commissioners of wrecks and shipwrecked goods and of harbor masters to give immediate notice to the Department of Public Works of all shipwrecks and obstructions existing in tidewaters of their town or harbor. The Director may apply for federal reimbursement of removal expenses which might properly be paid thereby. Nothing herein shall impair the rights of riparian proprietors to construct wharves pursuant to law. (Marsee-Florida)

W70-01184

RHODE ISLAND PILOTAGE REGULATION.

R I Gen Laws Ann secs 46-9-1 thru 46-9-7 (1956).

Descriptors: *Rhode Island, *Navigation, *Admiralty, *Administrative agencies, Legislation, Boats, State governments, Leadership, Permits, Ships, Transportation, Legal aspects, Safety, Regulation.

It is the policy of Rhode Island to provide for safe navigation in state waters maintain a state pilotage system, and insure an adequate supply of well-qualified pilots. An independent State Pilotage Commission is created within the Department of Public Works. The duties of the Commission are set forth. Provision is also made governing: (1) which vessels are required to take pilots; (2) which vessels are exempt from this Act; (3) piloting without a license; and (4) qualifications for licensees. (Marsee-Florida)

W70-01186

THE ASWAN HIGH DAM, Texas Univ., Austin.

For primary bibliographic entry see Field 06B.
W70-01201

FIELD EVALUATION OF SEEPAGE MEASUREMENT METHODS,

Idaho Univ., Moscow; and Agricultural Research Service, Kimberly, Idaho. Snake River Research Center.

C. E. Brockway, and R. V. Worstell.

Second Seepage Symposium, Proceedings, Phoenix, Arizona, Mar 25-27, 1968. Agricultural Research Service, Washington, DC, ARS 41-147, 1969. 7 p, 3 fig, 2 tab.

Groundwater Management—Group 4B

Descriptors: *Seepage, *Seepage losses, *Evaluation, *Canal seepage, *Field tests, Ponding, Ponding tests, Measurement, Reaches (Distance), Idaho, Costs, Field data.
Identifiers: Seepage meters, Inflow-outflow measurement, Minidoka Project (Idaho).

Experiments with ponding tests, seepage meters, and inflow-outflow methods for measuring seepage from canals were conducted in 1965-66 on the Minidoka Project in Idaho. The ponding test is the most accurate but the most expensive. Using seepage meters for obtaining estimates is fast and economical; however, new types of meters capable of functioning in canals at operating depth should be developed and studied. Almost all available meters are capable of measuring seepage with reasonable accuracy, but discretion must be used in the amount of confidence placed in average values determined from meter tests. The procedure outlined for estimating the number of meter tests required can be used to judge the confidence to be placed in any group of tests. Inflow-outflow methods are usually too expensive for short-duration seepage measurements; however, a good installation does indicate seasonal changes in loss rates. Accuracy of inflow-outflow determinations is limited by flow-measuring devices, but for canals with large seepage losses, inflow-outflow methods may be the most expedient and sufficiently accurate. (USBR)
 W70-01236

REVIEW OF METHODS FOR MEASURING AND PREDICTING SEEPAGE,
 Agricultural Research Service, Phoenix, Ariz.
 Water Conservation Lab.
 Herman Bouwer, and Robert C. Rice.
 Second Seepage Symposium, Proceedings, Phoenix, Arizona, Mar 25-27, 1968. Agricultural Research Service, Washington, DC, ARS 41-147, 1969. 6 p, 12 ref.

Descriptors: *Seepage, *Canal seepage, *Reviews, *Measurement, Ponding tests, Methodology, Forecasting, Seepage losses, Hydraulic conductivity, Water table, Ponding, Infiltration, Electric analogs, Instrumentation, Mathematical analysis, Hydraulic models.
Identifiers: Inflow-outflow measurement, Salt penetration method, Seepage meters.

Direct measurement of seepage can be obtained by inflow-outflow, ponding, seepage-meter, and salt-penetration techniques. Salt penetration is a recently developed tracer technique whereby seepage is determined from the rate of advance of dissolved salt in the bottom material. Advantages and disadvantages of the various techniques are discussed. Another approach for obtaining quantitative seepage information is to calculate the seepage rate from the hydraulic conductivity profile of the soil and the position of the groundwater table. Solutions can be obtained by mathematical analysis or by analog or model studies. Analyses by resistance network analog and the resulting dimensionless graphs for determining the seepage rate are discussed. In certain cases, knowing seepage in relation to time after water has entered a dry channel will be of interest. This is a problem of 2-dimensional infiltration, showing how simplified solutions can be obtained. (USBR)
 W70-01238

4B. Groundwater Management

MOVEMENT OF DDT AND NITRATES DURING GROUND-WATER RECHARGE,
 Robert S. Kerr Water Research Center, Ada, Okla.
 For primary bibliographic entry see Field 05B.
 W70-00861

VALUATION OF A GROUNDWATER SUPPLY FOR MANAGEMENT AND DEVELOPMENT,
 Nevada Univ., Reno. Desert Research Inst.
 P. A. Domenico.

Tech Rep Ser H-W Hydrol Water Resources Publication No 3, Reno, July 1967. 46 p, 1 fig, 38 ref.

Descriptors: *Groundwater mining, *Water management (Applied), *Mathematical models, *Optimization, *Resource development, Decision making, Water rights, Water levels, Economics, Monetary benefits.

Problems of groundwater management and development in terms of valuation of a resource or property that represented a source of future money receipts were discussed. A mathematical model was developed which gave both present worth of gains forthcoming from resources exploitation over a variable time period, and the remaining worth of a groundwater supply after it had been partially depleted. With the water level position selected as the denominator common to both the system and its economic worth, a course of exploitation was charted so that (1) present worth of future returns was maximized, and (2) water rights were protected to the extent that water levels were not lowered below the economic limit of pumping. The results enabled a conceptual valuation of (1) decision rules for efficiency in management, (2) optimal mining yield for specified conditions, and (3) the state of development of the resource at any time. (Thiuri-Cornell)
 W70-00904

A CONJUNCTIVE OPERATION OF A SURFACE RESERVOIR AND A GROUNDWATER AQUIFER,
 Technion - Israel Inst. of Tech., Haifa.
 For primary bibliographic entry see Field 02A.
 W70-00906

BASIC CONCEPTS IN GROUND WATER LAW,
 A. P. Black.
 Am Water Wks Ass'n J, Vol 39, No 10, p 989-1001, Oct 1947. 13 p, 15 ref.

Descriptors: *Groundwater, *Legislation, *Water utilization, *Water allocation (Policy), Administration, Competing uses, Consumptive use, Domestic water, Beneficial use, Reasonable use, Riparian rights, Percolating water, Withdrawal, Priorities, Well regulation, Administrative agencies, Water rights, Water law, Prior appropriation, Preferences (Water rights).

The growing need for legislation to deal adequately with the use of ground water supplies is examined. The author discusses the limitations and advantages of the three major rules which are the basis of most legislation on ground water rights: the common-law doctrine, the American rule of reasonable use, and the doctrine of prior appropriation. The author suggests the following basic concepts which should be incorporated into legislation for the control of ground water. Beneficial use should be the basis, the measure, and the limit to the use of water. The program should be administered on the state level by an agency with the power, subject to judicial review, to determine water rights. Vested rights to the use of water should be recognized to the greatest extent consistent with existing conditions in the area. Use of water for domestic purposes should be specifically exempted from the provisions of the statute. Reasonable limits, within which a later appropriation could rightfully lower the head of water, should be included. Finally, the right of eminent domain should assure towns and cities water supplies adequate for present and future use. (Gabrielson-Florida)
 W70-00914

RECORDS OF SELECTED WELLS AND SPRINGS IN THE RULISON PROJECT AREA, GARFIELD AND MESA COUNTIES, COLORADO,
 Geological Survey, Denver, Colo.
 For primary bibliographic entry see Field 07C.
 W70-00987

GROUNDWATER IN SANTA BARBARA COUNTY, CALIFORNIA, SPRING 1967 TO SPRING 1968,
 Geological Survey, Menlo Park, Calif.
 For primary bibliographic entry see Field 07C.
 W70-00989

VILLAGE WATER SUPPLY INVESTIGATION, TERRITORY OF PAPUA AND NEW GUINEA,
 Bureau of Mineral Resources, Geology and Geophysics, Canberra (Australia).
 For primary bibliographic entry see Field 03B.
 W70-00991

A GROUNDWATER QUALITY SUMMARY FOR ALASKA,
 Alaska Univ., College. Inst. of Water Resources. Steve W. Kim, Phillip R. Johnson, and R. Sage Murphy.

Available from the Clearinghouse as PB-187 683, for \$3.00 in paper copy, \$0.65 in microfiche. Project Completion Report, Alaskan Institute of Water Resources, Report No IWR-10, 1969. 32 p, 13 tab, 5 fig, 4 ref. OWRR Proj A-022-ALAS.

Descriptors: *Groundwater, *Water quality, Arctic, Cold regions, Water distribution.
Identifiers: *Alaskan groundwater quality.

This report is a termination report based upon data obtained from various governmental agencies operating in the state of Alaska. Groundwater quality data is presented for 465 analyses at 123 remote Alaskan locations. Data presented includes location, date sampled, and the following chemical analyses: iron, chloride, total dissolved solids, hardness, alkalinity, and color.
 W70-01087

BASIC WATER USE DOCTRINES AND STATE WATER CONTROL AGENCIES.
 For primary bibliographic entry see Field 04A.
 W70-01131

WATER RESOURCES.

Miss Code Ann secs 5956-31 thru 5956-34, 5956-36 thru 5956-39 (Supp 1968).

Descriptors: *Mississippi, *Water resources, *Well regulations, *Drilling, Drilling equipment, Well permits, Wells, Permits, Water law, Administrative agencies, Adjudication procedures, Regulation, Inspection, Control, On-site investigations, Legislation, Legal aspects.

Every person desiring to engage in the business of drilling wells for water shall file an application with the State Board of Water Commissioners for a drilling license. This shall not apply to persons drilling wells on their own land. Such licenses must be renewed yearly. The Board of Water Commissioners shall be empowered to make rules and regulations and give examinations. When the Board believes there has been a violation of its rules, it shall give notice of the desired remedial action or notice of a hearing. If the offender desires he may request a hearing. The grounds for revocation are specified in this statute. The Board is empowered to appoint an advisory board to make recommendations for the regulation and control of drillers. Any person who engages in well drilling in violation of this act shall be guilty of a misdemeanor. (Darragh-Florida)
 W70-01156

PATTERNS OF WATER USE IN THE ARIZONA ECONOMY,
 Arizona Univ., Tucson. Dept. of Agricultural Economics.
 For primary bibliographic entry see Field 06D.
 W70-01202

Field 04—WATER QUANTITY MANAGEMENT AND CONTROL

Group 4C—Effects on Water of Man's Non-Water Activities

4C. Effects on Water of Man's Non-Water Activities

CALCULATION OF WATER POLLUTION BY SURFACE RUNOFF,

For primary bibliographic entry see Field 05B.

W70-01026

CIVIL LAW PROPERTY--ENCROACHMENTS ON RIVER BANKS BY RIPARIAN OWNERS,

Gillis W. Long.

La L Rev, Vol 9, No 4, p 542-545, May 1949. 4 p, 16 ref.

Descriptors: *Louisiana, *Banks, *Public rights, *Land tenure, Judicial decisions, Legislation, Riparian rights, Relative rights, Riparian land, Civil law, Structures, Buildings, Water law, Cities, Navigable waters.

And elementary legal principle is that the banks of navigable streams are public. The Louisiana courts have traditionally been uniform in sustaining injunctions preventing erection and ordering removal of permanent installations on property subject to this public servitude. Early Louisiana law provided that it was sufficient to warrant removal of a structure if the public use was merely obstructed or 'interrupted.' Early cases provided that the owners of riparian land could not use the bank as private property, and encroachments could be removed at the instance of municipal officers or by individuals living within the municipal corporation. Article 862 of the Louisiana Civil Code allows minor encroachments upon banks and has occasionally been invoked when the interference with the bank was negligible or the cost of removal was prohibitive. In Town of Madisonville v Dendinger, 38 So 2d 252 (La 1948), the court seems to have altered the basis for removal of structures from the more restrictive 'obstruct or embarrass the use' test to allowing the structure to remain under Article 862, unless it 'prevents the use' of the bank by the public completely. The court felt the plaintiff had not made out a case of prevention of use, and the decision marks a permissive trend which may be explained by a decline in water transportation and a rise in the need of industry to utilize bank space. (Harris-Florida)

W70-01135

MILLS, DAMS, AND CERTAIN OTHER WORKS ON WATERCOURSES.

For primary bibliographic entry see Field 04A.

W70-01178

4D. Watershed Protection

ANNOTATED BIBLIOGRAPHY ON HYDROLOGY AND SEDIMENTATION, 1963-65, UNITED STATES AND CANADA.

Engineering-Science, Inc., Los Altos, Calif.

For primary bibliographic entry see Field 02J.

W70-00837

THE ENVIRONMENT--AND WHAT TO DO ABOUT IT,

Atomic Energy Commission, Washington, D.C.

Glenn T. Seaborg.

Nucl News, Vol 12, No 7, p 35-43, July 1969. 8p.

Descriptors: *Environment, *Ecology, *Pollution abatement, *Balance of nature, *Air pollution, *Water pollution, Environmental effects, Environmental engineering, Environmental sanitation, Fish and wildlife, Natural resources, Man, Conservation, Technology, Water pollution control, Water pollution effects, Waste disposal, Thermal pollution.

Identifiers: Air pollution control, Pollution control.

Environment has become an emotionally charged word on a par with such phrases as 'student revolts' or 'Raquel Welch,' depending upon which emotion you want charged. The facts and projections on environmental prospect are frightening and the challenge must be met, but we also suffer from misunderstanding, and need a rational outlook to clarify man's relationship with the environment. Talking of the balance of nature is quite fashionable today, implying that with a hands-off policy, natural process would somehow adjust all to everyone's benefit; this is not true. Nature pollutes and destroys; history records many earthquakes, volcanic eruptions, floods, and plagues. Modern man cannot be totally objective when his own survival is at stake; he must occasionally do some tampering with the balance of nature to favor himself. Man-made environment problems are a result of population growth, excessive and unplanned use of technology, neglect and lack of self-imposed standards, and inability to anticipate detrimental effects of a technology. The problems will not be solved by turning off a faucet marked technology. The difficult task ahead will take new thinking, cooperation among many people, and choosing between new alternatives. (USBR)

W70-01106

05. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification of Pollutants

GEOLOGY, PETROLEUM DEVELOPMENT, AND SEISMICITY OF THE SANTA BARBARA CHANNEL REGION, CALIFORNIA,

Geological Survey, Washington, D.C.

For primary bibliographic entry see Field 05B.

W70-00836

APPLICATION OF PYROLYtic GAS CHROMATOGRAPHY TO NATURAL WATERS,

Rocketdyne, Canoga Park, Calif. Research Div.

K. H. Nelson, and I. Lysyj.

Water Research, Vol 3, No 5, p 357-365, May 1969. 9 p, 7 fig, 20 ref. Office of Saline Water Contract 14-01-0001-965.

Descriptors: *Pollutant identification, *Gas chromatography, *Analytical techniques, *Organic compounds, Organic matter, Water quality, Streams, Reservoirs, Ecological distribution, Water properties, Water chemistry.

Identifiers: *Pyrolytic gas chromatography.

A modified pyrographic technique for characterization of nonvolatile organics in aqueous solutions is described. This method was developed from a pyrolytic procedure for the determination of the total organic content of natural waters. In the modified technique, pyrolysis of the organic matter without prior separation from the water is followed by gas chromatographic separation and flame ionization detection of the produced organic fragments. The organic composition of the samples then can be calculated from the pyrolytic spectrums. The method was applied to natural waters from several localities in the western part of the United States. Differences were observed in the number and intensities of peaks on the pyrograms. Investigations are underway to develop, improve, and adapt the technique for determination of organic matter in water, both particulate and dissolved, and to determine the role of organic matter in stream ecology. (Carstea-USGS)

W70-00847

A RAPID FOR MEASURING THE ACUTE TOXICITY OF DISSOLVED MATERIALS TO MARINE FISHES,

National Inst. for Water Research, Congella (South Africa). Regional Lab.

J. A. Ballard, and W. D. Oliff.

Water Research, Vol 3, No 5, p 313-333, May 1969. 21 p, 12 fig, 13 tab, 7 ref.

Descriptors: *Analytical techniques, *Toxicity, *Pollutants, *Dissolved oxygen, Poisons, Phenols, Fish, Lethal limit, Water temperature, Dissolved oxygen analyzers.

Identifiers: *Acute toxicity measurement, *Marine fish poisoning, Fish diseases.

A method is given for measuring the toxicity level of dissolved poisonous substances to fish. This rapid residual oxygen method is compared with the routine 24 or 48 hr test. The residual oxygen concentration at the time of fish death is measured either with a galvanic cell oxygen analyser probe or by titration using the oxide modification of the Winckler method. Effects of varying the densities per unit volume of test fishes, water temperature, and size of the fish were examined. A high fish density per unit volume reduces the exposure time and as a general rule toxicity is detected at higher concentrations of poison. Mercuric chloride showed no difference between the toxicity threshold at 15 deg C, 20 deg C and 25 deg C. In contrast, at 15 deg C, the toxicity for phenol is lowered to a concentration that is only one third that measured at 25 deg C. The grouping of fish according to size resulted in a reduced coefficient of variation. The test is simple and results are available in 8 hr. (Carstea-USGS)

W70-00849

PHYSICAL AND BIOCHEMICAL ASPECTS OF BOD KINETICS,

Technische Hochschule, Karlsruhe (West Germany). Lehrgebiet für Ingierbiologie.

For primary bibliographic entry see Field 05C.

W70-01024

STATISTICAL CHARACTERIZATION OF MIXTURES OF HYDROCARBONS,

J. Ruchti, and H. R. Krahenbuhl.

Water Research, Vol 2, No 1, p 26, Jan 1968.

Descriptors: *Pollutant identification, *Gas chromatography, *Methodology, Surface waters, Fuels, Oil, Pollutants, Statistical methods, Soils, Sewerage.

Identifiers: Hydrocarbon mixtures.

The paper describes a gas chromatography method used to identify the hydrocarbons (oils and fuels) in surface water, sewerage, and soils. The gas chromatograms for various commercial oils and fuels which were characterized by the average retention times are presented. The sensitivity of the method and its practical applications in identifying and measuring various pollutants of hydrocarbon nature are discussed. (Carstea-USGS)

W70-01025

THE CLASSIFICATION OF WATER QUALITY FROM THE BIOLOGICAL POINT OF VIEW,

Wolf Von Tunpling.

Water Research, Vol 2, No 1, p 40-42, Jan 1968. 1 fig, 1 tab, 10 ref.

Descriptors: *Bioindicators, *Water quality control, *Water quality, Biological properties, Watershed management, Dissolved oxygen, Biochemical oxygen demand, Statistical methods, Physical properties, Water chemistry.

Identifiers: *Water quality classification, Biological factors.

Statistical methods were used to correlate several biological parameters of water quality and to determine the probability of exceeding limiting values. A biological classification was selected because biological parameters have higher stability than chemical and physical parameters. The 4 classes of water quality are characterized by dissolved oxygen, oxygen saturation deficit, 2-day BOD, 5-day BOD, and ammonium ions. (Carstea-USGS)

W70-01029

Sources of Pollution—Group 5B

THE USE OF A DIGITAL SIMULATION SYSTEM FOR THE MODELING AND PREDICTION OF WATER QUALITY,
R. T. Jaske.

Water Research, Vol 2, No 1, p 37-40, Jan 1968. 3 fig, 5 ref.

Descriptors: *Model studies, *Simulation analysis, *Tracers, *Thermal pollution, *Water pollution control, Water quality control, Digital computers, Dispersion, Streamflow, Dissolved oxygen, Reservoir storage, Nuclear reactors, Radioactive wastes, Density currents, Columbia River.

Identifiers: *Digital simulation, Water quality prediction.

Cooler water was released from the lower levels of Lake Roosevelt to reduce the water temperature of the Columbia River in the vicinity of Hanford nuclear plant. Manual computation of water quality became impractical because additional impoundments produced changes in circulation patterns. Therefore, a digital computer simulation system was developed using actual stream measurements for comparison. The computer program was modified to include stochastic consideration of density currents and the resulting one dimensional model had relatively good linear dispersion characteristics. Weather data were taken from Hanford station which was considered to represent a regional pattern. Simulation of conservative and non-conservative substances was included in the system. Sodium dichromate and radioactive tracers were used to simulate downstream concentrations. The model can be easily adapted to any regional system or any specific stream, and was used to study the potential thermal modification of Illinois rivers. Modeling of dissolved oxygen and reservoir storage are possible by adaption of the original program. (Carstea-USGS)

W70-01030

THE PREDICTION OF THE DISTRIBUTION OF DISSOLVED OXYGEN IN RIVERS,
For primary bibliographic entry see Field 05B.

W70-01033

APPROACH TO DETERMINE THE MINIMUM ALLOWABLE FLOW IN THE TISZA RIVER, HUNGARY,
For primary bibliographic entry see Field 05G.

W70-01035

BACTERIAL AND PROTOZOAN INDICATORS OF WATER POLLUTION - STATISTICAL AND EXPERIMENTAL APPROACH,
V. Straskavoba, and M. Legner.

Water Research, Vol 2, No 1, p 8-12, Jan 1968. 7 fig, 1 tab, 7 ref.

Descriptors: *Water pollution, *Bioindicators, Protozoa, Bacteria, Biochemical oxygen demand, Bioassay, Statistical methods, Running waters, Stagnant water, Aquatic microorganisms.

Identifiers: Water pollution bioindicators.

Bacteriological methods were used to establish quantitative relationships between organisms and water pollution in running and stagnant waters. The number of bacteria estimated by membrane filter methods showed a linear relationship with the biochemical oxygen demand. There was no difference in slope of the curves between running and stagnant waters. The agar method also showed linear relationship between number of bacteria and biochemical oxygen demand for running water and sewage samples. At the same biochemical oxygen demand values, the numbers of bacteria in samples from stagnant water was lower than in those from running water. The experimental data showed good agreement with those obtained in other counties by using slightly different methods. A direct relationship was found between the prediction of ciliates and the organic load (water pollution). (Carstea-USGS)

W70-01036

THE WATER QUALITY PROTECTION PLAN. EFFICIENT MEANS TO ASSURE RATIONAL USE IN HYDROGRAPHIC BASINS (FRENCH),
S. Antonius.

Water Research, Vol 2, No 1, p 4-6, Jan 1968.

Descriptors: *Water quality control, *Water pollution control, *Water resources development, Water supply, Hydrography, Stream improvement, Hydrologic data, River basin development, Watershed management, Water management (Applied), Mathematical models, Model studies
Identifiers: *Water quality model, Hydrographic basin.

A water quality protection plan includes collection of fundamental data such as water use, sources of pollution, hydrological, physical and chemical characteristics of the rivers in the basin and interpretation of collected data using a mathematical model, to establish the corrective scheme. The nature and sources of water pollution are correlated with water users and water sources. This calculation will permit the evaluation of water quality properties (BOD, suspended material, toxic substances and temperature). The water manager will be able to control the water pollution and take necessary steps to purify the polluted water. It is recommended that the water quality model should be periodically revised as to reflect the economic and social changes in the basin. (Carstea-USGS)

W70-01038

SAMPLING AND ANALYSIS OF WASTE WATER FROM INDIVIDUAL HOMES (TASK 2),American Society of Civil Engineers, New York.
For primary bibliographic entry see Field 08B.

W70-01050

USE OF A SELECTIVE ION ELECTRODE FOR DETERMINATION OF NITRATE IN SOILS,
Iowa State Univ., Ames. Dept. of Agronomy.
J. M. Bremner, L. G. Bundy, and A. S. Agarwal.
Analytical Letters, Vol 1, No 13, p 837-844, 1968.
4 tab, 6 ref.

Descriptors: *Chemical analysis, *Nitrates, *Soil analysis, Nitrogen compounds, Soil chemistry, Instrumentation, Ions, Electrodes, Hydrogen ion concentration, Soil texture, Organic matter, Sulfates, Phosphates, Chlorides, Nitrates, Pollutant identification.

Identifiers: *Electrodes (Selective ion), Orion nitrate electrode, Nitrate-nitrogen, Temperature effects, Nutrient sources.

A method for precise and accurate measurement of nitrate concentration in soil extracts and soil-water suspensions with the Orion nitrate electrode is described. Techniques for preparation of soil suspensions which produced maximal nitrate-nitrogen values in all soils studies are delineated. Recoveries of known amounts of added nitrate were quantitative with soil samples which varied widely in pH, texture, and content of organic matter. No effects of pH and temperature were found in pH ranges of 5 to 8 and temperature ranges from 15-30 deg C. Use of calcium chloride (0.01 Molar) in place of distilled water in soil suspensions greatly reduced or eliminated interference by other anions, principally sulfate, dihydrogen phosphate, chloride, and nitrite, but reduced the sensitivity of the method. (Byrnes-Wisconsin)

W70-01075

5B. Sources of Pollution**GEOLOGY, PETROLEUM DEVELOPMENT, AND SEISMICITY OF THE SANTA BARBARA CHANNEL REGION, CALIFORNIA,**
Geological Survey, Washington, D.C.
J. G. Vedder, R. F. Yerkes, T. H. McCulloch, R. M. Hamilton, and H. C. Wagner.
Geol Surv Prof Pap 679, 1969. 77 p, 5 fig, 3 plate, 77 ref, 5 append.

Descriptors: *Oil fields, *Geology, *Water pollution sources, Oil reservoirs, Stratigraphy, Oily water, Drilling, Geologic investigations, Structural geology, Faults (Geology), Land subsidence, Rock mechanics, Seismology.

Identifiers: Santa Barbara Channel Oil Field (Calif).

During normal development of an oil pool on the Rincon structural trend, about 6 1/2 miles southeast of Santa Barbara, California, a gas blowout occurred on Jan. 28, 1969. Until Feb. 7, when the well was killed by cementing, uncontrolled flow led to local oil pollution of the sea surface. Reservoir damage during this period caused moderate and steady oil seepage. This seepage, estimated to be 30 barrels per day from March through June 1969, was reduced by early September to less than 10 barrels per day by drilling and grouting. Information is presented to help provide better understanding of the structural geologic, stratigraphic, and seismic framework of the Channel region and of the circumstances relating to the oil seepage. In 1968, the channel area produced 22.9 million barrels of oil, about 6% of California's production. Cumulative oil production at the end of 1968 was about 1.1 billion barrels, or about 7 1/2% of California's total production. Dry gas production in 1968 was about 12% of the State production. The large production of the Rincon trend fields is attributable to thick, oil-saturated sections and relatively high porosities and permeabilities. The Santa Barbara Channel region is seismically active: since 1900 it has experienced two earthquakes of magnitude 6, and in 1812 it was the site of a shock that may have attained magnitude 7. (Knapp-USGS)

W70-00836

MOVEMENT OF DDT AND NITRATES DURING GROUND-WATER RECHARGE,Robert S. Kerr Water Research Center, Ada, Okla.
Marion R. Scalf, William J. Dunlap, Leslie G. McMillion, and Jack W. Keeley.
Water Resources Res, Vol 5, No 5, p 1041-1051, Oct 1969. 12 p, 10 fig, 1 tab, 19 ref.

Descriptors: *Path of pollutants, *Groundwater movement, *DDT, *Nitrates, *Tracking techniques, Tracers, Water wells, Pumping, Recharge, Discharge (Water), Adsorption, Dispersion.

Identifiers: Aquifer tests, Pumping tests, Ogallala aquifer.

The Robert S. Kerr Water Research Center, U. S. Department of the Interior, and Southwestern Great Plains Research Center, U. S. Department of Agriculture, recently cooperated in a field investigation of the fate of DDT and nitrates when artificially recharged into the Ogallala aquifer. The USDA provided recharge and observation wells and hydraulic equipment for injecting 350 gpm of water with known concentrations of radioactive tracer, DDT, and nitrates. Following 10 days of recharge, the recharge well was pumped for 12 days at 500 gpm. During recharge the nitrates moved to the observation wells essentially at the same rate as the recharge water, and the DDT was absorbed to the aquifer material very near the recharge well. During the pumping phase, 94% of both the recharge water and the nitrates was recovered. The concentration of DDT in the pumped water was about 16 times the recharged concentration at initiation of pumping but dropped below recharge concentration within one hour. Apparently a major portion of the DDT introduced during recharge was not recovered during pumping but remained in the aquifer. (Knapp-USGS)

W70-00861

THE USE OF THE FUNDAMENTAL STUDIES OF BIOLOGICAL PURIFICATION ON THE PURIFICATION OF POLLUTED WATERS DERIVED FROM PRODUCTION OF 'KHEMLON' (SLOVAKIAN),For primary bibliographic entry see Field 05D.
W70-00879

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5B—Sources of Pollution

SOME THERMAL CHARACTERISTICS OF TWO RIVERS IN THE PENNINE AREA OF NORTHERN ENGLAND,
Durham Univ. (England). Dept. of Geography.
K. Smith.
Journal of Hydrology, Vol 6, No 4, p 405-416, Aug 1968. 6 fig, 4 tab, 18 ref.

Descriptors: *air temperature, *Water temperature, Air-water interfaces, Thermal stratification.
Identifiers: Air-water temperature relationship, Northern England.

This paper examines water temperature data obtained over a 4 year period (1958-1961) for two adjacent rivers in northern England. The thermal regime is compared at upstream and downstream sites on each river, and the relationships between river water and air temperatures are also discussed. It is emphasized that a satisfactory explanation of the variations revealed is only possible through a consideration of both climatological and hydrological factors. (Guerrero-Vanderbilt)
W70-00881

PHYSICAL MODELING OF REGIME OF BODIES OF WATER TO STUDY THEIR SANITATION CONDITION (IN RUSSIAN), State Hydrological Inst., Leningrad (USSR).

V. A. Znamenskyi.
Nauchnyie doklady po voprosam samootschishchena vodoyemov i smeshcheniya stochnykh vod, p 188-199, Tall Pol Inst, Tallinn ESSR, 1965.

Descriptors: *Model studies, *Mathematical models, Hydraulic models, Hydraulic similitude, Turbulence, Water quality, Reynolds number, Froude number, Waves, Thermal properties, Tidal effects.

The most effective way of solving the problem of either hydrodynamic behavior of bodies of water or dilution processes in them is a combination of theoretical computations with physical modeling. This paper deals mainly with the mathematical modeling of hydrodynamic behavior of estuaries and takes into account the effects of wind and tidal wave propagation. The difference of discharges coming into the body of water and going out is expressed as delta Q=Sxu, where S is the surface area and u is the velocity of change in depth. According to measurements in the Neva estuary near Leningrad, this discharge difference can be 10-20 times higher than the inflow rate. The influence of temperature and thus the density distribution is also discussed. The space modeling which is described must take into account the gravity, inertial and viscosity forces. Dye and salt were used as a representation of pollution in these space models. It is concluded that the use of space models yields solutions to many problems of water quality behavior in the receiving waters. (Novotny-Vanderbilt)
W70-00885

MATHEMATICAL SIMULATION OF THE ESTUARINE BEHAVIOR AND ITS APPLICATIONS,
General Electric Co., Philadelphia; and Federal Water Pollution Control Administration, Philadelphia, Pa.
For primary bibliographic entry see Field 05C.
W70-00896

THE RELATION OF ION MOVEMENT TO FINE PARTICLE DISPLACEMENT IN A SAND BED,

Georgia Inst. of Tech., Atlanta.

Jerry B. F. Champlin.

Available from the Clearinghouse as PB-187 521, \$3.00 in paper copy, \$0.65 in microfiche. Water Resources Center, Georgia Institute of Technology, WRC-0369, July 1969. 22 p. OWRR Proj A-002-GA.

Descriptors: *Ion transport, *Radioactive tracers, *Ion movement, *Ion adsorption, *Porous media, *Sand filters, Radioisotopes, Ion exchange, Trace elements, Aquifers, Radioactivity, Radioactive waste disposal, Water purification, Water quality.
Identifiers: Scandium, Rubidium, Lanthanum.

Determination of the fundamental mechanisms by which trace metals and organic compounds are fixed or immobilized by the soil and sediments of the earth from water moving through aquifers is the research objective. Dilute water suspensions (model wastes) were passed through packed sands (model soils), forming a horizontal simulated aquifer 2 meters long, 1 meter wide and 1/4 meter thick. Retention of radioactivity added to water, to suspended clay, and to suspended bacteria by the sand bed was investigated, using radioisotopes of rubidium, lanthanum and scandium. In general, some of the radioactivity originally in solution transferred to fines derived from the sand bed and passed through into the effluent. A significant portion of the radioactivity initially placed on the clay also passed through the sand bed. None of the radioactivity added to the bacteria passed through the sand bed into the effluent. The research established that significant movement of ionic matter through porous beds of soils can take place in the form of dilute suspensions at low salt concentrations; and that direct transfer to free ions through packed beds at low dissolved salt concentrations is unlikely. (Conway-Georgia Tech)
W70-00909

TEMPORAL, HORIZONTAL AND VERTICAL VARIABILITY OF WATER CHEMISTRY IN UNSATURATED ZONE OF FINE-GRAINED SOILS,

Idaho Univ., Moscow. Water Resources Research Inst.

Roy E. Williams.

Available from the Clearinghouse as PB 187 523, \$3.00 in paper copy, \$0.65 in microfiche. Research Technical Completion Report, Idaho Water Resources Research Institute. June 1969. 31 p. 3 tab, 3 fig, 3 ref. OWRR Proj A-021-IDA.

Descriptors: Soil chemistry, Soil analysis, Soil chemical properties, *Soil moisture meter, *Infiltration, *Ion transport, *Water pollution sources.

A method was developed for extracting water samples from unsaturated soils under low moisture content and concomitant high tension. A sample collection cell was constructed by enclosing a hydrophytic, cross-linked, dextran xerogel in seamless, dialyzer tubing with opening diameters of 48 angstroms. When the cell is placed in contact with a soil, water and its dissolved ions move through the membrane and into the hydrophytic substance. Because the ion exchange capacity of the xerogel is negligible, the water and ions can be replaced by distilled, deionized water and the effluent analyzed. However, chemical analysis of the effluent has revealed that results are not reproducible and that unreasonably high concentrations of some ions often result. Combination tracer and infiltration tests have demonstrated that water moves through the loess soils of northern Idaho via discontinuities as well as through intergranular pore spaces. Whether the discontinuities are operative in the infiltration process depends on the surface condition and on the application rate. These must permit a saturated layer to form above the discontinuities before they can begin to water preferentially. (Corey-University of Idaho)
W70-00911

MEASUREMENT OF COLUMBIA RIVER FLOW TIME FROM HANFORD REACTORS TO ASTORIA, OREGON-SUMMER 1966,

Oregon State Univ., Corvallis.

For primary bibliographic entry see Field 02E.

W70-01002

CALCULATION OF WATER POLLUTION BY SURFACE RUNOFF,

N. A. Pravoshinsky, and P. D. Gatillo.

Water Research, Vol 2, No 1, p 24-26 Jan 1968.

Descriptors: *Water pollution sources, *Water quality, *Surface runoff, *Water pollution control, Pollutants, Water properties, Oil, Snowmelt, Sewage, Biochemical oxygen demand, Statistical methods, Suspended load, Chlorides, Coliforms.
Identifiers: *Urban runoff, *USSR, Minsk, Soligorsk, Street washings.

Water pollution by surface runoff was studied (1964) in two districts of Minsk and in 1966 from the Soligorsk area. The main index of pollution was the 5-day BOD. Suspended solids, chlorides, oil products and coliform counts were also determined. Water from asphalt surfaces was more polluted than the water from unpaved areas. The amount of pollutants in runoff water was about 13% of the amount measured in raw domestic sewage. Statistically analyzed data show a relationship between water quality and stream flow. The stream character, duration of the preceding dry weather period, seasonal variation, and the type of surface were also condensed in the interpretation and application of data. The study was divided into sections based primarily on hydraulic properties and the way pollutants reach the water course. The concentration of pollutants, their rate of purification, total BOD, oxygen concentration, amount of suspended solids and number of bacteria revealed differences between rivers and ponds. (Carstea-USGS)
W70-01026

STUDIES ON NATURAL FACTORS AFFECTING PHOSPHATE ABSORPTION AND ITS UTILIZATION BY ALGAE,

M. Owens, and G. Knowles.

For primary bibliographic entry see Field 05C.

W70-01031

THE PREDICTION OF THE DISTRIBUTION OF DISSOLVED OXYGEN IN RIVERS,

M. Owens, and G. Knowles.

Water Research, Vol 2, No 1, p 20-21, Jan 1968. 2 p.

Descriptors: *Dissolved oxygen, *Mathematical models, *Mixing, *Diffusion, *Tracers, Analytical techniques, Aeration, Water management (Applied), Rivers, Water temperature, Solar radiation, Streamflow, Aquatic plants.
Identifiers: Dissolved oxygen prediction, River management.

A simple mathematical model is given to be used for predicting the changes in oxygen content in rivers. The basic processes responsible for changes in oxygen content are mathematically expressed using river flow, surface area between two stations and the oxygen concentrations at the stations. A series of empirical relations was developed to describe the influence of environmental conditions upon the dissolved oxygen content. Water temperature, intensity of solar radiation and average biomass of aquatic plants were used in predicting the oxygen content. Calculated and observed dissolved oxygen distributions were in fairly good agreement in unpolluted streams. The mixing coefficients derived by tracer techniques were introduced in the refined mathematical model. The potential applications of the model in water management is also discussed in the paper. (Carstea-USGS)
W70-01033

THE WATER QUALITY PROTECTION PLAN. EFFICIENT MEANS TO ASSURE RATIONAL USE IN HYDROGRAPHIC BASINS (FRENCH),

For primary bibliographic entry see Field 05A.

W70-01038

Sources of Pollution—Group 5B

STUDIES ON ALGAL SUBSTANCES IN THE SEA. II. THE FORMATION OF GELBSTOFF (HUMIC MATERIAL) BY EXUDATES OF PHAEOPHYTA,

Norwegian Inst. of Seaweed Research, Trondheim.
John McN Sieburth, and Arne Jensen.
J Experimental Marine Biology and Ecology, Vol 3,
p 275-289, 1969. 7 fig, 4 tab, 20 ref.

Descriptors: *Oceans, *Marine algae, *Seawater, *Humic acids, *Phaeophyta, *Exudation, Ecology, Phenols, Carbohydrates, Chromatography, Dialysis, Bogs, Sulphates, Pulp and paper industry, Proteins, Ultraviolet radiation, Fluorescence, Larvae, Pigments, Salinity, Hydrogen ion concentration, Temperature, Pulp wastes, Streams, Effluents, Littoral, Spectrophotometry, Water pollution sources.

Identifiers: *Gelbstoff, *Algal substances, *Fucus vesiculosus, Norway, Laminaria hyperborea, Ascophyllum nodosum, Fractionation, Pleuronectes platessa, Olisthodiscus, Trondheim (Norway), Blue fluorescing material, Sublittoral zone, Nylon column technique.

Preliminary observations on exudation from Fucus vesiculosus confirm the importance of this process in ecology of inshore waters. Algae, maintained in the laboratory for 24 hours, exuded 500-800 milligrams of phenolic, and 1.0-1.5 grams of carbohydrate materials per kilogram dry weight of Fucus. Qualitative studies on standing exudates from three important Norwegian seaweeds show that exudates form humic substances (Gelbstoff) inseparable from that present in seawater. Observations based on paper chromatography, dialysis, Sephadex fractionation and recombination of fractions led to elaboration of a hypothesis for Gelbstoff formation from algal exudates. Brown seaweeds exude a few simple, potentially phenolic precursors; these form polyphenols in alkaline seawater which rapidly react with proteinaceous and carbohydrate material, the resulting complexes constituting a considerable part of marine Gelbstoff. The larger molecular complexes of Gelbstoff are continually precipitating to form organic aggregates. Similar transformations of phenolic precursors to soluble Gelbstoff complexes and the subsequent formation of colored precipitates take place in bog water and in sulphate effluents. Common mechanisms, involving simple phenols, proteinaceous, and carbohydrate matter, may result in formation of terrestrial and marine Gelbstoff. (Jones-Wisconsin)
W70-01073

STUDIES ON ALGAL SUBSTANCES IN THE SEA. III. THE PRODUCTION OF EXTRACELLULAR ORGANIC MATTER BY LITTORAL MARINE ALGAE,

Rhode Island Univ., Kingston. Narragansett Marine Lab.

John McN Sieburth.
J Experimental Marine Biology and Ecology, Vol 3,
p 290-309, 1969. 1 fig, 18 tab, 26 ref.

Descriptors: *Oceans, *Marine algae, *Littoral, *Organic matter, Exudation, Tides, Photosynthesis, Solar radiation, Salinity, Rainfall, Temperature, Colorimetry, Carbohydrates, Phenols, Nitrogen, Respiration, Carbon, Primary productivity, Oxygen, Metabolism, Wind velocity, Humidity, Bacteria, Hydrogen ion concentration, Sulfates, Respiration, Food chains.

Identifiers: *Algal substances, *Extracellular, Fucus vesiculosus, Chondrus crispus, Ascophyllum nodosum, Laminaria digitata, Laminaria agardhii, Desiccation, Immersion, Narragansett Marine Laboratory (Rhode Island), Dilution rate, Fruiting bodies, Ulva lactuca var latissima, Polysiphonia harveyi, Epiphytic bacteria, Sublittoral, Yellow material, Dumontia incrassata, Emerson.

Sunlit and darkened Fucus vesiculosus accumulate no dissolved organic matter in closed systems, in which problem of bacterial growth was not entirely overcome. Open systems, with seawater dilutions, consistently accumulated appreciable quantities of

extracellular organic carbon. Exudation in Fucus, coupled directly with photosynthesis, increased with solar radiation. Two Laminaria produced exudation in the dark. Reducing salinity of seawater apparently diminished organic matter exudation rate by Fucus. Organic carbon is lost upon re-immersion of dissicated Fucus in seawater. Algal clumps on exposed rocks lost some 39 milligrams carbon/100 grams. Light natural rainfall more effectively extracts organic carbon than artificial rainfall. Nature of exudates, determined by colorimetric assay, revealed that carbohydrates are most abundant, followed by equal amounts of nitrogenous and polyphenolic material. During spring conditions, Fucus exudes approximately 30% of total or 40% of net carbon fixed daily. Since biomass of carbon in Fucus beds can exceed 1000 grams/square meter and algae minimally fix 6.5 grams/square meter/day, Fucus exudation of organic matter equal 5.7 grams carbon/square meter/day. (Jones-Wisconsin)
W70-01073

STUDIES ON ALGAL SUBSTANCES IN THE SEA. I. GELBSTOFF (HUMIC MATERIAL) IN TERRESTRIAL AND MARINE WATERS,

Norwegian Inst. of Seaweed Research, Trondheim.
John McN Sieburth, and Arne Jensen.
J Experimental Marine Biology and Ecology, Vol 2,
p 174-189, 1968. 8 fig, 1 tab, 24 ref.

Descriptors: *Oceans, *Marine algae, *Seawater, *Fresh water, *Humic acids, *Color, Rivers, Bogs, Phenols, Pigments, Organic matter, Biomass, Benthic flora, Phaeophyta, Polar regions, Spectrophotometry, Chromatography, Hydrogen ion concentration, Fluorescence, Carbohydrates, Temperature, Salinity, Ultraviolet radiation, Sulfates, Cellulose, Industries, Water pollution sources.

Identifiers: *Gelbstoff, *Algal substances, Subpolar waters, Tynset (Norway), Nid River (Norway), Gaula River (Norway), Flakk (Norway), Ranheim (Norway), Trondheimsfjord (Norway), Smola (Norway), Hitra (Norway), Froya (Norway), Fucus vesiculosus, Ascophyllum nodosum, Ectocarpus confervoides, Nylon column technique, Particulate matter, Blue fluorescing material, Yellow material, Fractionation.

Dissolved yellow colouring matter of terrestrial and marine waters was concentrated in nylon columns. A concentration factor of 10,000 was obtained with a recovery of approximately 70%. The method allowed isolation of a reference "Gelbstoff" of marine origin used to estimate Gelbstoff concentrations in bog (17 milligrams/liter (mg/l)), river (about 1 mg/l), and sea water (0.003-0.8 mg/l). Seasonal and geographical variation of Gelbstoff concentration in sea water was observed. Methods based on spectra and differential spectra were inadequate for characterization of different types of yellow material from terrestrial and sea water; they are apparently derived from polyphenols. Fair separation of Gelbstoff was effected from different sources by a method of two-dimensional paper chromatography, which they developed. Marine Gelbstoff could be distinguished from both river and bog water pigments. A considerable fraction of terrestrial Gelbstoff precipitated rapidly in contact with sea water. Content and characteristics of marine Gelbstoff are variable, and is undetectable during January, February, and March. Part of the yellow color of sea water is due to particulate organic matter, which is largely amorphous and shows polyphenol staining. Precipitating Gelbstoff may be a major source of these organic aggregates. (Jones-Wisconsin)

W70-01073

ABOUT THE QUESTION OF VERTICAL MIXING OF WASTE WATERS IN CLOSED RESERVOIRS (In Russian),

A. M. Aitsam, L. L. Paal, and H. A. Tibar.
Sbornik statei po sanitarnoi tekhnike III, Trudy talinskogo politekhnicheskogo instituta, seria A, No 233, p 99-107, 1966.

Descriptors: *Mixing, Reservoirs, Mathematical models, Water pollution, Laplace's equations, Wave lengths, Waste dilution.

The problem of vertical mixing caused by wave formation is theoretically solved. This vertical mixing is dependent on the coordinates (x,y,z), on the reservoir depth, h, and on the characteristics of the wave (height, length, and period). To obtain the velocity potential, integration of Laplace's equations is necessary. Using the Lagrange integral the following equation was obtained involving the coordinate of the free surface, Z (B)= f (x,y,t). In order to solve this equation it was assumed that the height of the wave is relatively small in comparison with its length. Fourier's method was used to find the velocity potential Phi. Vertical mixing in reservoirs is caused by the vertical component of the velocity, V (Z). Using a derived equation, the vertical flow of liquid through an elemental area dw=ldx can be computed and the total mass flow of liquid was found by integration. The validity of the equations obtained was verified in a laboratory flume where a dye was used for modeling of pollution. The paper is an attempt to estimate the influence of waves on the mixing of waste waters in closed reservoirs. (Novotny-Vanderbilt)
W70-01078

SWEETWATER POLLUTION,

Larry Paul Wasserman.
Sci and Tech, No 90, p 20-27, June 1969. 8 p.

Descriptors: *Water conservation, *Water pollution, *Pollution abatement, *Fresh water, Wastes, Waste water treatment, Water pollution effects, Waterfowl, Pollutants, Radioactive wastes, Water pollution treatment, Water quality, Water resources, Fish and wildlife, Thermal pollution, Ecology, Marshes, Eutrophication, Aquatic life, Estuaries.

Identifiers: Pollution control, Biological magnification.

The earth's fresh water supply is not a constant, and is being reduced by man's wanton use. The problem arises from pollution and wasted water and from insidious circumstances resulting from such activities as land filling along shorelines and marshes. Pollution problems from sewage, industrial wastes, agricultural chemicals, and eutrophication are reviewed. Landfills of marshes, estuaries, or river shores produce adverse ecological changes, destroying valuable breeding grounds for many forms of aquatic life, waterfowl, and other wildlife. Radioactive materials released in even minute quantities present a great hazard because the radioactive material can become progressively concentrated to dangerous levels in various forms of animal life. Thermal pollution, sedimentation, and salt water intrusion problems are discussed. Current approaches to pollution problems are merely stopgap approaches. The principal ingredient needed to counteract the growing water pollution dilemma is money--money to run a conservation organization, to preserve and set aside lands, to run treatment plants, and to coordinate plans on national and state levels. (USBR)
W70-01104

CITY AIR - BETTER OR WORSE,

Public Health Service, Washington, D.C.

H. E. Landsberg.
SEC Technical Report A 62-5, Symposium, Air Over Cities, Cincinnati, Ohio, Nov 1969. 22 p, 3 fig, 4 tab, 65 ref.

Descriptors: *Temperature, *Climates, *Air pollution, Wind velocity, Precipitation.

Identifiers: *Human activities, Public hygiene.

Extreme human activity has caused considerable changes in local climates. These modifications in big cities in turn have increased the temperature by 1 to 1.5 deg F on an annual basis, diminished diurnal temperature range, flattened the shape of diurnal temperature curve, decreased the relative hu-

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5B—Sources of Pollution

midity by 6%, increased the amount of precipitation by 10%, and decreased the speed of winds by 20 to 30%. In addition dust particles have increased by 10 fold, SO₂ by 5 fold, CO₂ by 10 fold, and CO by 25 fold. Radiation has decreased by 15 to 20% and ultra-violet radiation in the winter is 30% less. There is 100% more fog in the winter and 10% more clouds. These effects have probably only a minor influence upon human well-being. Other changes, however, have potentially harmful effects. The most radical effect has been on atmospheric suspensions and admixtures. None of these changes have been beneficial. The growth of nearly all urban areas and industrial complexes has outpaced the engineering and legal efforts to minimize the nuisance and the possible danger of contamination. Our knowledge of air quality and its effects on health is not yet adequate. In the interest of public hygiene, an intense effort in bio-meteorological and medical research is required. (Upadhyaya-Vanderbilt)
W70-01239

THE THERMAL CLIMATE OF CITIES,

Public Health Service, Washington, D.C.

J. M. Mitchell, Jr.

SEC Technical Report A62-5, Symposium, Air Over Cities, Cincinnati, Ohio, Nov 1969. 15 p, 9 fig, 2 tab.

Descriptors: *Air temperature, *Solar radiation, *Urban areas, Population, Cloud cover, Wind velocity, Lapse rate, Turbulent mixing.

Identifiers: *Urban heat island, Nocturnal inversions.

The urban 'heat island' and other aspects of the anomalous temperature distribution in San Francisco, San Jose, Palo Alto, New Haven, Vienna and a number of other cities are discussed. Heat island of a city is weaker on Sundays, when the city is comparatively dormant, than on other days of the week, when it is bustling with activity which indicates that these islands are man-made. As the city grows in size and population the increase of the intensity of urban heat island has been observed. The urban heat island is most evident at night. Daily maxima and minima of temperature are reached slightly later in the city than in suburbs, and the daily range is less in the city. The contributory causes of heat island are, on a summer day, solar radiation is more readily absorbed in the city by building and paving materials possessing large heat storage capacities, and on a winter day, the streets and buildings are warmed by the furnace heat. Sundborg found that the nighttime urban-rural temperature difference, D, could be approximated by $D = (a - bN)/V$ where N is % cloud cover, V is wind speed, a and b are constants. (Upadhyaya-Vanderbilt)
W70-01241

5C. Effects of Pollution

EFFECT OF POLYELECTROLYTES IN CONJUNCTION WITH BENTONITIC CLAY ON CONTAMINANTS REMOVAL FROM SECONDARY EFFLUENTS,

Technion - Israel Inst. of Tech., Haifa. Sanitary Engineering Lab.

For primary bibliographic entry see Field 05D.

W70-00845

ESTIMATES OF PERIPHYTON MASS AND STREAM BOTTOM AREA USING PHOSPHOROUS-32,

Oak Ridge National Lab., Tenn. Radiation Ecology Section.

For primary bibliographic entry see Field 021.

W70-00846

THE DIURETIC RESPONSE BY RAINBOW TROUT TO SUB-LETHAL CONCENTRATIONS OF AMMONIA,

Ministry of Agriculture, Fisheries and Food, London (England). Salmon and Freshwater Fisheries Lab.

R. Lloyd, and L. D. Orr.

Water Research, Vol 3, No 5, p 335-344, May 1969. 10 p, 6 fig, 19 ref.

Descriptors: *Ammonia, *Rainbow trout, *Toxicity, Lethal limit, Streams, Estuaries, Fish, Water properties, Fish management, Water temperature, Dissolved oxygen, Carbon dioxide, Alkalinity, Water quality.

Identifiers: *Diuretics, Ammonia toxicity.

Ammonia is one of the most common pollutants in rivers and estuaries. The degree of ammonia toxicity is dependent upon pH, water temperature, bicarbonate alkalinity, dissolved oxygen, carbon dioxide. The diuretic affects of ammonia on rainbow trout were studied in relation to effect of ammonia concentration, the time-lag in diuretic response, effect of temperature, and acclimation to sub-lethal concentrations of ammonia. The rate of urine excretion by rainbow trout increases with increase in the concentration of ammonia probably because of the increase in the permeability of fish to water. It is suggested that any environmental factor which affects the water balance of fish may also influence their susceptibility to ammonia poisoning. (Carstea-USGS)

W70-00848

A RAPID FOR MEASURING THE ACUTE TOXICITY OF DISSOLVED MATERIALS TO MARINE FISHES,

National Inst. for Water Research, Congella (South Africa). Regional Lab.

For primary bibliographic entry see Field 05A.

W70-00849

WATER QUALITY CRITERIA FOR EUROPEAN FRESHWATER FISH - WATER TEMPERATURE AND INLAND FISHERIES.

European Inland Fisheries Advisory Commission. Working Party on Water Quality Criteria for European Freshwater Fish.

Water Research, Vol 3, p 645-662, 1969. 3 tab, 103 ref.

Descriptors: *Freshwater fish, *Temperature, *Effects, *Standards, Heated water, Fish food organisms, Acclimatization, Lethal limit.

In this report, tentative temperature criteria are proposed for European inland fisheries. No account is taken of the effect of pollution. It was essential to make a distinction between the temperature conditions permissible at different times of the year and to assess not only maximum permissible temperatures but also maximum permissible increments of temperature. Winter—An increase in water temperature of 2 deg C from about 0 deg C in winter at the time of reproduction of burbot would destroy this species. Raising the temperature 5-6 deg C in autumn and winter may affect salmonids. Spring—A rise of 5-6 deg C is detrimental to pike embryos. The majority of cyprinids tolerate an increase of temperature of 8-10 deg C during the embryonic stage. Adult fish can usually tolerate a wider range of temperature than embryos. It seems likely that if water temperature gets near the disturbing level most species would continue to feed. Summer—For salmonids of the genus *Salmo*, 20-21 deg C should be accepted as the upper permissible temperature during the warmest season of the year. Coregonids can withstand a rise of temperature of 5-6 deg C but the maximum for the summer months should not exceed 22-23 deg C. For many cyprinids, the permissible increase of temperature is about 6 deg C above the natural ambient values, with an upper limit of 30 deg C during the warmest season. (Speakman-Vanderbilt)
W70-00880

WASTEWATER DISPOSAL AND MICROBIAL ACTIVITY AT ICE-CAP FACILITIES,

Army Terrestrial Sciences Center, Hanover, N.H.

S. C. Reed, and W. Tobiasson.

Journal, Water Pollution Control Federation, Vol 40, No 12, p 2013-2020, Dec 1968. 6 fig, 1 tab, 5 ref.

Descriptors: *Ice, *Snow, *Sewage disposal, Anaerobic digestion.

Identifiers: *Thermal degradation, Greenland, *Icecap.

The physical development of the wastewater disposal pits used at two permanent stations on the Greenland Ice Cap was defined with temperature sensing thermocouples and a sonic range finding device. Physical measurements indicate that the disposal pit contained within the snow mass of the ice cap grows to a diameter of 220 ft. Thermal degradation of the snow mass by this pit will have detrimental settlement effects on any facility located within 300 feet of the outfall point. Temperature of the liquid in the pit remained a constant 32 deg F. Hydrogen sulfide production was measured in the pit but methane was not detected; this indicates that at least a preliminary stage of an aerobic decomposition is occurring. (Rietveld-Vanderbilt)
W70-00882

MATHEMATICAL SIMULATION OF THE ESTUARINE BEHAVIOR AND ITS APPLICATIONS,

General Electric Co., Philadelphia; and Federal Water Pollution Control Administration, Philadelphia, Pa.

J. M. Jeglic, and G. D. Pence.
Soc Econ Planning Sci, Vol 1, No 3, p 363-389, July 1968. 27 p, 19 fig, 8 ref.

Descriptors: *Simulation analysis, *Estuarine environment, *Mathematical models, *Water quality control, *Optimization tidal waters, Forecasting, Delaware River, Dispersion, Advection, Droughts, Dissolved oxygen.

The cause and effect relationships as applied to important water quality parameters were described. Presented were the steps in the development of a mathematical model representing the dispersion and advection of dissolved oxygen in a one dimensional tidal environment, using mass balances on finite volumes. The goal of the study was to develop a rational means of estimating the cause and effect relationships, so that accurate forecasts of the results of proposed control systems could be obtained and assurances could be made that a control program had a reasonable chance of success. The verification of the model was made using a year of actual data on the Delaware estuary. During the 1965 draught the salt water intrusion in the Delaware was examined on a thirty-day basis so that corrective measures could be taken. The mathematical model presented proved to be a valuable tool in the analysis of estuarine behavior. (Thiuri-Cornell)
W70-00896

THE DEVELOPMENT AND DISTRIBUTION OF PLANKTON IN THE NORTHERN PART OF THE WHITE NILE,

Khartoum Univ. (Sudan). Dept. of Zoology.

For primary bibliographic entry see Field 021.

W70-01007

STRONTIUM-90 CONCENTRATION FACTORS OF LAKE PLANKTON, MACROPHYTES, AND SUBSTRATES,

Akademiya Nauk URSR. Inst. of Biology of the Southern Seas.

Z. Kalnina, and G. Polikarpov.

Science, Vol 164, No 3887, p 1517-1519, June 1969. 3 p, 4 tab, 12 ref.

Descriptors: *Water chemistry, *Eutrophication, *Strontium radioisotopes, Sediment, Plankton,

Effects of Pollution—Group 5C

Aquatic life, Water pollution sources, Water pollution effects, Flame photometry, Nuclear wastes.
Identifiers: *USSR, *Latvia.

The ratio of concentration of strontium-90 in living and inert lake components to that in lake water (concentration factors) was determined for plankton, macrophytes, and substrates in eutrophic, mesotrophic-eutrophic, and dystrophic lakes. Concentration factors of strontium-90 in aquatic organisms and substrates are higher in a dystrophic lake than in the other types. (Knapp-USGS)
W70-01010

PHYSICAL AND BIOCHEMICAL ASPECTS OF BOD KINETICS,

Technische Hochschule, Karlsruhe (West Germany). Lehrgebiet für Ingieurbiologie.
Ludwig Hartmann, and Peter Wilderer.

Water Research, Vol 2, No 1, p 30-37, Jan 1968. 10 fig, 7 ref, 2 append.

Descriptors: *Biochemical oxygen demand, *Biodegradation, *Water pollution effects, Activated sludge, Organic loading, Physical properties, Diffusion, Pollutants, Chemical reactions, Turbulence.

Identifiers: *Biochemical reaction kinetics, Reaction rates.

Two main theoretical concepts are generally accepted to describe the BOD process: (1) Biochemical concept considers that biochemical reactions within the cell are responsible for the reaction rates; (2) physical concept emphasizes convection and diffusion processes during the transport of organic pollutants to and through the living cell. A set of experiments used biochemical methods to evaluate and describe BOD kinetics. A constant substrate concentration was brought into contact with various amounts of activated sludge. It was impossible to use one mathematical formula to describe the whole BOD process. Second order reactions were the best approximation to evaluate the process at low load values. In this case, turbulence and other physical factors had a positive influence upon the process. Biochemical reactions were responsible for the rate of BOD reaction only at high load values. (Carstea-USGS)
W70-01024

THE CLASSIFICATION OF WATER QUALITY FROM THE BIOLOGICAL POINT OF VIEW,

For primary bibliographic entry see Field 05A.

W70-01029

THE USE OF A DIGITAL SIMULATION SYSTEM FOR THE MODELING AND PREDICTION OF WATER QUALITY,

For primary bibliographic entry see Field 05A.

W70-01030

STUDIES ON NATURAL FACTORS AFFECTING PHOSPHATE ABSORPTION AND ITS UTILIZATION BY ALGAE,

Joseph Shapiro.

Water Research, Vol 2, No 1, p 21-23, Jan 1968. 2 fig, 3 ref.

Descriptors: *Eutrophication, *Nutrients, *Water pollution sources, *Phosphates, Algae, Water pollution treatment, Water quality control, Sewage effluents, Absorption, Lakes.

Identifiers: *Phosphate absorption.

The accumulation of nutrient elements in water, particularly nitrogen and phosphorus, favors the process of eutrophication. Previous experiments have shown that different factors are present in natural waters which inhibit or facilitate the use of phosphate by algae. The 'phosphate sparing factor' was studied by using lake water and microcysts aeruginosa as the test organism. Ion exchange resins were used to determine an ionic factor that facilitated the use of phosphate by microcysts. Ad-

dition of salts increased the rates of phosphate uptake by the algae in diluted lakes; however, nitrate seemed to be the most important factor. More experimental work using different algae and chemical components are in progress. (Carstea-USGS)
W70-01031

AVOIDANCE REACTIONS OF SALMONID FISH TO REPRESENTATIVE POLLUTANTS,

John B. Sprague.
Water Research, Vol 2, No 1, p 23-24, Jan 1968.

Descriptors: *Water pollution effects, *Pollutants, Limnology, Rainbow trout, Phenols, Chlorine, Detergents, Sewage effluents, Pesticide toxicity, Toxicity, Atlantic salmon.

Identifiers: *Avoidance reactions, Salmonid fish.

Small rainbow trout or Atlantic salmon were used in laboratory experiments to test avoidance reactions against zinc sulfate, phenol, ABS detergent, chlorine and bleached Kraft pulp mill effluent. Strong avoidance reaction to sublethal concentration occurred only for one (zinc sulfate) of the five pollutants used. Phenol is not avoided at all, whereas chlorine and ABS detergent could cause avoidance responses at concentrations that are expected in polluted waters. The avoidance threshold of Atlantic salmon for metal pollution was found to be about 18 times higher in nature than in laboratory tests. The salmonid fishes have different responses for different kinds of pollution depending upon the characteristics inherited from their natural habitats. (Carstea-USGS)
W70-01032

ON THE DIFFUSION PHENOMENA IN BOUNDARY LAYERS OF TURBULENT FLOW AND ITS INFLUENCE ON THE COURSE OF THE SELF-PURIFICATION OF SMALL STREAMS,

V. Novotny.

Water Research, Vol 2, No 1, p 6-8, Jan 1968.

Descriptors: *Diffusion, *Self-purification, Dissolved oxygen, Mass transfer, Turbulent flow, Oxygenation, Biochemical oxygen demand, Turbulent boundary layers, Rivers.

Identifiers: *Self-purification (Rivers).

The rate of self-purification of water is dependent upon the ratio of the bottom organisms to the river flow. The quantity of nutrients which diffuse from the free water surface to the bottom is a determining factor for the biological activity of benthic organisms. Diffusion phenomena and mass transfer of water are described mathematically. In addition to turbulent flow, a diffusive boundary layer should be considered when dealing with diffusion phenomena. A mathematical approach was applied to calculate the deoxygenation coefficient by using data from streams rich in bottom growths. Control of BOD in streams is possible if the hydraulic conditions of the stream are known. (Carstea-USGS)
W70-01037

THE INFLUENCE OF ALGAL ANTIBIOSIS ON THE ECOLOGY OF MARINE MICROORGANISMS,

Rhode Island Univ., Kingston. Narragansett Marine Lab.

John McNeill Sieburth.

Advances in Microbiology of the Sea, Academic Press, New York, Vol 1, p 63-94, 1968. 8 fig, 122 ref.

Descriptors: *Algae, *Ecology, *Marine microorganisms, Phytoplankton, Bactericides, Algal toxins, Larvae, Phenols, Shellfish, Oysters, Industries, Chelation, Bacteria, Streptococcus, Secondary productivity, Sulfides, Sea water, Phaeophyta, Crustaceans, Herbivores, Chlorophyll, Enzymes, Peptides, Biochemistry, Hydrogen ion concentration, Oxidation, Diatoms, Epiphytology, Metabolism, Primary productivity, Fluorescence, Isotropy, Tritium, Symbiosis, Temperature, Copepods, Protozoa, Zooplankton, Solar radiation, Pseudo-

domonas, Parasitism, Physiological ecology, Water pollution sources, Water pollution effects.

Identifiers: *Antibiosis, Autolysis, Excretion, Depuration, Phycocolloids, Tannins, Flagellates, Pharmaceuticals, Extracellular products, Chemical resistance, Euphausia, Phaeocystis, Sargassum, Fronds, Hydrocarbons, Bacterial attachment, Ecotocarpus, Polysiphonia, Organic aggregates, Seasonal effects.

Author reviews the role in marine ecology of antibiosis resulting from excretion of substances secondarily excreted by algae, a subject contributing to the much larger picture of microbial interactions. Photosynthetic plants are primarily important to heterotrophic microbiota as providers of primary nutritional substances. Conversely, heterotrophic bacteria may markedly influence the nutrition and success of marine plants, presumably resulting from modification of excreted and autolytic products by depolymerization and mineralization into usable nutrients, production of growth and morphogenetic factors for algae, and by detoxification of inhibitory substances. When possible, such processes should be studied in concert, rather than separately. Realization that algal products may benefit, modify, and even suppress early life stages of marine animals reemphasizes the importance of interdisciplinary attacks on ecology. Field studies promise to demonstrate factors which influence suppression, selection, dominance, and succession of marine microorganisms. Any such studies must include consideration of effects of extracellular secretions. Author summarizes his knowledge and understanding of the nature and influence of inhibitory secondary plant materials in marine environments to encourage continued investigation of algal antibiosis. (Jones-Wisconsin)
W70-01068

NITROGEN FIXATION BY GLOEOCAPSA,

North Texas State Univ., Denton. Water Research Lab.

J. T. Wyatt, and J. K. G. Silvey.
Science, Vol 165, p 908-909, Aug 1969. 1 tab, 18 ref. FWPCA Grants WP-00805-04, WP-00985-04.

Descriptors: *Cyanophyta, *Nitrogen fixation, Reduction (Chemical), Chromatography, Optical properties, Bacteria, Nitrogen cycle, Water pollution effects, Eutrophication, Cycling nutrients.

Identifiers: *Gloeocapsa, Ethylene production, Acetylene reduction, Phormidium faveolarum, Heterocyst, Chroococcus, Cylindrospermum, Nostoc muscorum, Nostoc commune, Tolypothrix distorta, Nutrient sources.

Continuous growth of the cyanophyte (blue-green alga) Gloeocapsa, in a medium free of combined nitrogen, with experimental production of ethylene via acetylene reduction, indicates that nitrogen fixation by cyanophytes is not solely confined to filamentous genera with heterocysts. Axenic cultures of Gloeocapsa, adapted to nitrate-free medium, form ethylene at rates comparable to those of known nitrogen-fixers. Special control measures precluded the possibility of responses being falsely attributed to Gleocapsa. Authors also tested uninoculated gassed samples and cultures of Phormidium faveolarum, a non-nitrogen-fixer. Because earlier work indicated that no appreciable nitrogen fixation occurred in cyanophytes after prolonged exposure to darkness, authors adopted an arbitrary pretreatment period of 8 hours in darkness before incubation in dark-bottle and light controls. Thus, the ability of Gloeocapsa to reduce acetylene would suggest that heterocysts are not the site of nitrogen fixation, at least for this species of cyanophyte. This ability plus the facts that Gloeocapsa maintained both its vigor and an apparent normal growth rate over a period of 9 months in a medium free of combined nitrogen should establish it as a nitrogen-fixer. (Jones-Wisconsin)
W70-01070

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5C—Effects of Pollution

FACTORS AFFECTING THE GROWTH OF NAJAS IN PICKWICK RESERVOIR,
National Fertilizer Development Center, Muscle Shoals, Ala.
J. B. Martin, Jr., B. N. Bradford, and H. G. Kennedy.

National Fertilizer Development Center, Tennessee Valley Authority, Muscle Shoals, Alabama, Doc No F 70 ACD2, Oct. 1969. 19 fig, 18 tab, 8 ref, appendix.

Descriptors: *Plant growth, *Nutrient requirements, Carbon, Photosynthesis, Seeds, Sediments, Turbidity, Waves (Water), Eutrophication, Tennessee River, Industrial wastes, Municipal wastes, Nutrients, Sand, Potassium, Calcium, Magnesium, Sulfur, Alabama, Silts, Clay loam, Hydrogen ion concentration, Particle size, Iron, Copper, Manganese, Sodium, Alkalinity, Aeration, Springs, Streams, Quarries, Reservoirs, Light intensity, Tennessee, Tennessee Valley Authority Project, Sampling, Agricultural chemicals, Water pollution effects, Water pollution sources, Aquatic weeds, Bicarbonates, Carbonates, Environmental effects, Nitrates, Phosphates, Rooted aquatic plants, Sediment yield, Water quality.

Identifiers: *Najas minor, *Najas quadrangularis, *Pickwick Reservoir (Tenn-Ala), Zinc, Wilson Dam (Ala).

Authors investigated nutritional and environmental factors concerning recent infestations of *Najas* spp in Pickwick Reservoir (Tennessee-Alabama). Degree of infestation in any location could not be related to variations in the nutrient content of the reservoir water. *Najas* growth in the greenhouse was independent of nitrogen and phosphorus concentration of water, but was positively correlated with the bicarbonate ion content, the plants' source of carbon for photosynthesis via leaves and stems. Lake sediments supply inorganic nutrients via the plants' relatively weak root system. Plants rooted in a nutrient-free sand could not sustain growth, although submerged in a nutrient solution. However, variations in nutrient content of the lake sediments were apparently not responsible for presence or absence of *Najas* in any specific spot. That both sediments and water contribute essential factor(s) for *Najas*' growth is indicated by observations that plants grew normally rooted in sediment and immersed in reservoir water, whereas growth failed in similar plants immersed in demineralized water. Water depth, sediment load, turbidity, light penetration, seed introduction, wave action, and other environmental factors were cited as the controlling factors in distribution of *Najas*. Report includes appendix outlining analytical techniques and methods for greenhouse culture of *Najas*. (Jones and Nichols-Wisconsin)
W70-01071

SEASONAL CHARACTERISTICS OF TWO SALINE LAKES IN WASHINGTON,
Washington Univ., Seattle. Dept. of Zoology.
For primary bibliographic entry see Field 02H.
W70-01076

SOME LIMNOLOGICAL FEATURES OF A SHALLOW SALINE MEROMICTIC LAKE,
Washington Univ., Seattle. Dept. of Zoology.
For primary bibliographic entry see Field 02H.
W70-01077

LIMNOLOGICAL EFFECTS OF ORGANIC EXTRACTS OF LITTER IN A SOUTHWESTERN IMPOUNDMENT,
Arizona Univ., Tucson; and Arizona Cooperative Fishery Unit, Tucson.
For primary bibliographic entry see Field 02H.
W70-01080

POLLUTION—CAUSES, COSTS, CONTROLS.
For primary bibliographic entry see Field 06B.
W70-01100

IMPLICATION OF WATER QUALITY AND SALINITY IN THE SURVIVAL OF FRASER RIVER SOCKEYE SMOLTS,
International Pacific Salmon Fisheries Commission, New Westminster (British Columbia).
I. V. Williams.

International Pacific Salmon Fisheries Commission Progress Report, No 22, 1969. 8 fig, 15 tab, 25 ref.

Descriptors: *Sockeye salmon, *Herbicides, *Pesticides, *Salinity, Marine salmon, Metals, Detergents, Water quality.

Identifiers: *Migration seaward, *Marine survival, *Salinity preference, *Fraser River.

Seaward migrating juvenile sockeye (*Oncorhynchus nerka*) from five lakes in the Fraser watershed were examined in a preliminary attempt to define some of the factors causing variable marine survival to the adult stage. Water quality of rivers utilized by the seaward migrating smolts appeared to be acceptable. No toxicants in the form of heavy metals, herbicides, pesticides, or detergents were detected at lethal threshold concentrations. At the onset of migration, the different groups varied in their tolerance of sea water, but all could tolerate 30 parts per thousand (0/00) salinity within the time required to reach the estuary. Preference tests of smolt behavior in a vertical salinity gradient indicated a time lag from the onset of migration to the acceptance of sea water which increased in proportion to the distance between the individual lake of origin and the estuary. However, once each group of smolts had accepted sea water, little or no acclimation was needed to transfer smolts from fresh water directly into 30 0/00 salinity. A delay in salinity preference and tolerance relative to the onset of seaward migration is suggested as a possible factor related to variation in marine survival of sockeye smolts.
W70-01225

PATTERNS OF INSECTICIDE RESISTANCE IN THE MOSQUITO FISH, GAMBUSIA AFFINIS,
Mississippi State Univ., State College. Dept. of Zoology.

Dudley D. Culley, and D. E. Ferguson.
Journal Fisheries Research Board of Canada, Vol 26, No 9, p 2395-2401, 1969. 3 tab, 15 ref.

Descriptors: *Pesticide toxicity, *Chlorinated hydrocarbon pesticides, *Fish, Bioassay toxicity, *Organophosphorous pesticides.

Identifiers: *Mosquito fish, *Pesticide resistance.

The insecticide resistance of a resistant mosquito-fish population (Belzoni, Miss.) was compared to that of a sensitive population using 28 insecticides of 5 major groups (chlorinated hydrocarbons and organic phosphorous compounds). The 48-hour bioassay showed that the resistant fish had developed a tolerance only to the toxaphene-endrin related insecticides. The patterns of resistance in mosquito fish are similar to those in many resistant arthropods. (Katz-Washington)
W70-01226

WATER QUALITY CRITERIA FOR EUROPEAN FRESHWATER FISH; LIST OF LITERATURE ON THE EFFECT OF WATER TEMPERATURE ON FISH.

Food and Agriculture Organization of the United Nations, Rome (Italy). European Inland Fisheries Advisory Commission.

European Inland Fisheries Advisory Commission, Working Party on Water Quality Criteria for European Freshwater Fish, EIFAC Tech Paper No 8, Rome 1969. 8 p, 110 ref.

Descriptors: *Fish physiology, *Water temperature, *Bibliographies, Fish, Water pollution, Water quality.

Identifiers: *Water quality criteria, *Thermal pollution, *Temperature effects, *Temperature requirements.

A bibliography of over 100 references on the literature regarding the water temperature requirements of freshwater fish. Good coverage of Eastern European literature. (Katz-Washington)
W70-01227

WATER QUALITY CRITERIA FOR EUROPEAN FRESHWATER FISH; REPORT ON WATER TEMPERATURE AND INLAND FISHERIES BASED MAINLY ON SLAVONIC LITERATURE.
Food and Agriculture Organization of the United Nations, Rome (Italy). European Inland Fisheries Advisory Commission.

European Inland Fisheries Advisory Commission, Working Party on Water Quality Criteria for European Freshwater Fish, EIFAC Tech Paper No 6, Rome, 1968. 32 p, 85 ref.

Descriptors: *Fish, *Water pollution, *Water temperature, *Water quality, Fish physiology, Bibliographies, Acclimatization.

Identifiers: *Water Quality Criteria, *Temperature range, *Temperature acclimatization, *Seasonal temperature tolerance, *Salmonid temperature tolerance, Developmental stage.

A review of the European literature on thermal requirements of European Freshwater fish with particular attention to Eastern European sources and review which is designed to help formulate water quality criteria, indicate that fish differ in tolerance to high temperature. Tolerance varies with species, stage of development, acclimatization temperature, dissolved oxygen, and other pollution sources. In this review, temperature criteria are proposed which take no account of other pollution. Different temperatures are permissible at different times of the year. For salmonids, 20 to 21 deg C is the upper permissible temperature during summer while cyprinids can tolerate 30 deg C. (Katz-Washington)
W70-01228

CHRONIC TOXICITY OF ZINC TO THE FATHEAD MINNOW, PIMEPHALES PROMELAS RAFINESQUE,
Newton Fish Toxicology Lab., Cincinnati, Ohio.
William A. Brungs.

Transactions of the American Fisheries Society, Vol 98, No 2, p 272-279, Apr 1969. 8 tab, 1 fig, 16 ref.

Descriptors: *Bioassay, *Fish reproduction, Toxicity, Freshwater fish, Metals.

Identifiers: *Continuous flow bioassay, *Fathead minnow, *Chronic toxicity, *Fish production, *Fish survival, *Fish growth, Zinc, Application factor, 96-hr. median tolerance limit.

A continuous-flow bioassay was conducted for 10 months to determine the chronic effect of zinc on fathead minnows (*Pimephales promelas Rafinesque*). Fish production, as based on survival, growth, and reproduction, was investigated. Reproduction by the test fish was almost totally inhibited at zinc concentrations that had no effect on survival, growth, or maturation of these same fish. At these same concentrations there was also no effect on survival of control eggs and fry. The number of eggs produced per female in the low zinc concentration (0.18 mg/l) was only 17 percent of the eggs produced in the control (0.03 mg/l of zinc). Application factors based on these data and the 96-hour median tolerance limit (9.2 mg/l) are discussed. (Katz-Washington)
W70-01229

OIL POLLUTION OF THE SEA: IS THE END IN SIGHT,
Fauna Preservation Society, London (England).
C. L. Boyle.
Biological Conservation, Vol 1, No 4, p 319-327, July 1969. 1 tab, 2 fig, 25 ref.

Descriptors: *Oily water, *Birds, Waste water disposal.

Waste Treatment Processes—Group 5D

Identifiers: *Oil pollution marine, *Oil discharge, *Marine fauna, *Marine birds, *Cleaning marine birds, *Oiled marine birds, Deliberate oil pollution, International Conference on Oil Pollution of the Sea, Corexit, Oil slicks.

The chief cause of deliberate oil pollution at sea, the cleaning of oil tanks, is discussed and means of abolishing the practice are discussed. The effects of oiling on marine fauna, especially on birds, is discussed. Methods of cleaning oil from birds are described. The effects on shore life observed by the South African division of Sea Fisheries are reported. The toxic effects of oil slick dispersants (Corexit) on various aquatic forms are reported. (Katz-Washington)

W70-01230

RECOVERY OF A SALT MARSH IN PEMBROKESHIRE, SOUTH-WEST WALES, FROM POLLUTION BY CRUDE OIL,
Field Studies Council, Pembroke (England). Oil Pollution Research Unit.

E. B. Cowell, and J. M. Baker.
Biological Conservation, Vol 1, No 4, p 291-296, July 1969. 2 fig, 2 tab, 8 ref.

Descriptors: *Algal poisoning, *Marsh plants, *Oily water, Aquatic algae, Marine algae, Oil, Marsh, Pollutants.

Identifiers: *Salt marsh, *Oil pollution, *Recovery from pollution, *Kuwait crude, Bentlass Salt Marsh.

An account of the biological effects of a spill of Kuwait crude oil on the plants and algae of the Bentlass Salt Marsh near Pembroke, S.W. Wales. Some species of the marsh plants were more affected by the oil than others. Spill occurred in January 1967 but by June 1968, most of the species affected were showing some signs of recovery with the exception of *Triglochin maritima*. No animal observations. (Katz-Washington)

W70-01231

FISHERY MANAGEMENT WITH THE HELP OF THE ORGANOPHOSPHORUS INSECTICIDE, THIOMETON,
Bihar Univ., Muzaffarpur (India). Dept. of Zoology.

S. K. Konar.
Ichthyologica, Vol IV, Nos 1-2, p 28-36, 1965. 5 tab, 8 ref.

Descriptors: *Insecticides, *Fish control agents, *Fish management, *Piscicides, *Organophosphorus pesticides, Fish farming, Aquatic insects.

Identifiers: *Thiometon, Toxicity bioassays, Labeo, Notonecta.

Experiments were conducted to determine usefulness of Thiometon, an organic phosphorus insecticide in the management of the pond fish Labeo. The minimum lethal doses of Thiometon to Labeo and nine species of undesirable organisms was determined. The LD₀, LD₅₀, LD₁₀₀ of Thiometon vary from 0.50 to 6.4 ppm, 0.32 to 13.49 ppm, and 0.56 to 20 ppm respectively for fishes and from 0.008 to 0.40 ppm, 0.035 to 0.835 ppm and 0.05 to 2.0 ppm for insects. Except for Cyclops and Nauplius, all fish food organisms tolerate 1 ppm Thiometon. Thiometon is detoxified in 8 days in the field. (Katz-Washington)

W70-01232

A COMPOSITE RATING OF ALGAE TOLERATING ORGANIC POLLUTION,
Federal Water Pollution Control Administration, Cincinnati, Ohio.

C. M. Palmer.
Journal of Phycology, Vol 5, No 1, p 78-82, 1969. 11 tab, 29 ref.

Descriptors: *Algae, *Aquatic algae, *Aquatic environment, Pollutants, Biological communities, Water pollution effects, Diatoms.

Identifiers: *Pollution-tolerant algae, *Blue green algae, *Euglena, Pigmented flagellates.

From information on pollution-tolerant algae compiled from reports from 165 authors, the genera and species most often referred to as significant fall into a relatively stable series. Diatoms, pigmented flagellates, green, and blue-green algae are all well represented among the pollution-tolerant genera and species. The top 8 genera are Euglena, Oscillatoria, Chlamydomonas, Scenedesmus, Chlorella, Nitzschia, Navicula, and Stigeoclonium, and the top 5 species, Euglena viridis, Nitzschia palae, Oscillatoria limosa, Scenedesmus quadricauda, and Oscillatoria tenuis. In some genera, e.g., Euglena, a single species is far more significant than all others as a pollution-tolerant form. In other genera, e.g., Oscillatoria, only a slight difference distinguishes the pollution tolerance of 2 or more species. Algal genus and species pollution indices are presented for use in rating water samples with high organic pollution. (Katz-Washington)

W70-01233

SOME OBSERVATIONS OF CLOUD INITIATION IN INDUSTRIAL AREAS,
Public Health Service, Washington, D.C.

G. E. Stout.

SEC Technical Report A62-5, Symposium, Air Over Cities, Cincinnati, Ohio, p 147-153, Nov 1969. 2 fig.

Descriptors: *Clouds, *Air pollution, *Temperature, Tornadoes.

Identifiers: Industrial pollution.

Landsberg and Changnon have suggested that precipitation over an urban area is greater than over the rural area. Telford, of the CSIRO in Australia recently concluded that a portion of freezing nuclei in the atmosphere comes from certain types of industrial activity. A petro-chemical industry, located in the rural area of central Illinois, has been observed to initiate clouds. At least five cases are partially documented by surface, airborne, or radar observations. On one occasion a cumulus congestus cloud formed and produced tornado funnels. These clouds were formed at a small distance down wind from the heat source. No other clouds were present in the area. Preliminary occasional observations suggest that this industrial source could be used for an interesting research study of the possible influence of industrial pollution on cloud formation. (Upadhyaya-Vanderbilt)

W70-01240

5D. Waste Treatment Processes

EFFECT OF POLYELECTROLYTES IN CONJUNCTION WITH BENTONITIC CLAY ON CONTAMINANTS REMOVAL FROM SECONDARY EFFLUENTS,

Technion - Israel Inst. of Tech., Haifa. Sanitary Engineering Lab.

M. Rebhun, N. Narkis, and A. M. Wachs.
Water Research, Vol 3, No 5, p 345-355, May 1969. 11 p, 7 fig, 1 tab, 16 ref. Work partially sponsored by US Dept of Agri. Grant No FG-IS-148, USDA.

Descriptors: *Tertiary treatment, *Clays, *Coagulation, *Adsorption, *Flocculation, *Water reuse, Water quality, Water pollution, Chemical oxygen demand, Turbidity, Color, Organic matter, Phosphates, Nitrogen compounds, Organic compounds, Water purification.

Identifiers: *Residual organic removal, Secondary effluents.

The efficiency of flocculation by polyelectrolytes and clays in removing the residual organics and other refractory matter from secondary effluents was investigated. Attempts were made to clarify the mechanisms of interaction between the polyelectrolyte, the clay in the various refractory organics in secondary effluents. The parameters studied in

clude chemical oxygen demand, turbidity, color phosphate, nitrogenous compounds, and ABS. Cationic polyelectrolytes react with various substances in solution, particularly anionic organic matter. The reaction products are colloidal and do not settle rapidly. The bentonite removes some organic compounds, mostly nitrogenous organics. The mixture of bentonite and cationic polyelectrolytes improve the efficiency of organic removal and lowers the required flocculant dose. The clay itself removes 74% of the total COD. The surface reactions and mechanisms are also discussed in this paper. (Carstea-USGS)

W70-00845

THE USE OF THE FUNDAMENTAL STUDIES OF BIOLOGICAL PURIFICATION ON THE PURIFICATION OF POLLUTED WATERS DERIVED FROM PRODUCTION OF 'KHEMLON' (SLOVAKIAN),

Zdena Nanackova-Zekeova.

Russian and German summaries. Vyskumny Ustav Vodohospodarsky, Bratislavia, 1966. 79 p, 14 fig, 13 tab, 25 ref.

Descriptors: *Industrial wastes, *Industrial water, *Pollution abatement, *Biological treatment, Cotton, Runoff, Silts, Oxygen, Stagnant water, Phosphorus, Nitrogen, Air circulation, Oxidation, Biodegradation, Water reuse, Waste water treatment.

Identifiers: *Slovakia, Industrial waste water, Biological purification.

Purification of industrial waste water from the production of cotton material was investigated by using a method of silt activation. The success of the method depends on the concentration of fresh running water, optimal load, optimal time period of activation, concentration of activated silt, amount of feeding material, and the intensity of air circulation. The efficiency of purification also requires some addition of phosphorus, usually absent in fresh running waters. (Gabriel-USGS)

W70-00879

NUCLEAR POWER PLANT SITING IN THE PACIFIC NORTHWEST FOR THE BONNEVILLE POWER ADMINISTRATION,
Battelle Memorial Inst., Richland, Wash. Pacific Northwest Labs.

H. Harty, R. F. Corlett, and R. E. Brown.
Summary Research Report, Battelle-Northwest, July 1967. 50 p, 16 fig.

Descriptors: *Thermal pollution, *Cost analysis, Nuclear power plant.

Identifiers: *Siting consideration, *Public acceptance factor, *Site economic factor, Pacific Northwest site areas.

The factors which are taken into account for site selections are physical and environmental site factors, population of surrounding areas, geology and hydrology, meteorology, heat dissipation and biological effects. The significant factors in site cost are condenser size and cost, natural- and induced draft cooling towers, land and site preparation costs, site access, engineered safeguards and multiple-reactor siting. For the sites considered, the method of handling waste heat was the single most important economic variable. It was found that once-through cooling with fresh water was the most economical method of disposing of waste heat. Once-through cooling with salt water increased capital costs about \$3/kW and unit power costs about 0.045 mill/kW-hr. The use of cooling towers for waste heat discharge increased capital costs about \$10/kW and unit power costs about 0.14 mill/kW-hr. A major economic tradeoff exists among the method of handling waste heat, transmission costs, engineered safeguards costs (which tend to increase as sites approach many load centers, i.e., urban areas), land costs (generally higher near urban areas) and other factors. (Upadhyaya-Vanderbilt)

W70-00883

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5D—Waste Treatment Processes

COPING WITH COOLING TOWER BLOW-DOWN, T. C. Hoppe.

Industrial Water Engineering, p 27-32, Dec 1966. 5 fig, 8 ref.

Descriptors: *Thermal pollution, *Cooling tower, Chemical waste, Corrosion control, Cost comparison, Films.

Identifiers: *Corrosion inhibitor, Cooling water treatment, Tuberculation.

A case study is presented of industrial cooling water treatment with inflow process temperatures of 116°F to 350°F, and 90°F to 140°F out, with a maximum water temperature differential across the tower of 31°F. Well water was treated with acid for pH control, shock chlorination for biocide, and non-chromate proprietary blend of polyphosphates and polyvalent ions for corrosion inhibition. Operating experience showed severe corrosion and iron oxide and phosphate sludge deposits. A new corrosion inhibitor in the form of zinc, and biodegradable organic material, without chromate nor phosphates, was tried. Very good results were obtained, uniform protective film formation was evident, previous tuberculation decreased, and no sludge accumulated. Costs rose from \$0.0606 to \$0.1275 per 1000 gallons of makeup, but this was far less expensive than other alternatives. (Rietveld-Vanderbilt)

W70-00884

COOLING TOWERS FOR STEAM-ELECTRIC STATIONS - ECONOMIC APPLICATIONS, Ebasco Services Inc., New York.

Louis Elliott.

Transactions of the American Society of Mechanical Engineers, Vol 73, p 1027-1029, 1951. 3 fig, 1 tab.

Descriptors: *Cooling towers, *Steam, *Economic efficiency, Heated water, Condensation.

The objective of this study was to indicate a method for an economic comparison between direct use of river or pond water for condensing arrangement for a steam station and utilization of cooling towers. The comparison was made utilizing data on river temperatures and records of atmospheric temperature and humidity over a longer period. In a particular case studied, maximum plant capability of a cooling tower plant as compared with a direct condensing, is penalized by from 2 to 3 percent. Remarks on the cooling tower performance, location and orientation of towers are mentioned. Because a great deal of information is necessary to determine the best placement of a tower, research needs are mentioned. (Guerrero-Vanderbilt)

W70-00887

CATAD SYSTEM CONTROLS FOR REGULATION OF COMBINED SEWAGE FLOWS, Municipality of Metropolitan Seattle, Wash.; and Metropolitan Engineers, Seattle, Wash. Charles V. Gibbs, and Stuart M. Alexander.

Water and Wastes Eng, p 46-49, Aug 1969. 2 fig.

Descriptors: *Mathematical models, *Computer programs, *Sewers, *Storage capacity, *Storm runoff, Sewage disposal, Municipal wastes, Automatic control, Hydrologic properties.

Identifiers: Combined sewers.

The installation of a computer-augmented treatment and disposal (CATAD) system to utilize optimum storage within an existing municipal combined sewer system was described. The other objectives of CATAD were (1) to make available the maximum capacity of the interceptor for combined storm and sanitary flows in unseparated areas by utilizing the storage capability of trunk and interceptor sewers in separated areas; and (2) to control necessary overflows at selected locations so as to minimize harmful effects on marine life and public beaches. Control commands were generated internally by a computer under program control. A

mathematical model was developed in order to implement a fully automatic control. The model incorporated elements of meteorology and hydrology including seasonal precipitation patterns and areal runoff characteristics. An analysis of the regulation of stormwater inflows by the use of trunk sewer storage established the operating rules required for effective utilization of the available storage. (Thiuri-Cornell)

W70-00889

ANALYSIS AND OPTIMIZATION OF A REVERSE OSMOSIS PURIFICATION SYSTEM—PART II. OPTIMIZATION,

Kansas State Univ., Manhattan. Inst. for Systems Design and Optimization.

For primary bibliographic entry see Field 03A.
W70-00890

OPTIMIZATION OF THE ACTIVATED SLUDGE PROCESS—OPTIMUM VOLUME RATIO OF AERATION AND SEDIMENTATION VESSELS,

Kansas Univ., Lawrence. Dept. of Chemical and Petroleum Engineering; and Kyoto Univ. (Japan). Dept. of Chemical Engineering.

M. Naito, T. Takamatsu, and L. T. Fan.
Water Res, Vol 3, No 6, p 433-443, June 1969. 8 fig, 6 ref.

Descriptors: *Optimization, *Activated sludge, *Aeration, *Sedimentation, *Mathematical models, Mixing, Sludge treatment, Capital, Design, Volume.

Identifiers: Recirculated sludge.

A mathematical model was developed for optimizing the total activated sludge system. The optimum volume ratio of the aeration and sedimentation tanks and the recirculation ratio of the sludge were computed. The objective of the two computations was the minimization of the total capital cost and the total volume. Both objective functions gave almost the same results. Total capital cost increased with the increase of the mixing in the aeration tanks. The results obtained in the study were for steady state operation. It was found out that the optimum volume ratio of the aeration to sedimentation tanks and sludge recirculation did not vary greatly from the design conditions adopted in current plants. (Thiuri-Cornell)

W70-00893

A SYSTEMS APPROACH TO WASTE MANAGEMENT,

Massachusetts Univ., Amherst.

Richard J. Giglio, Donald D. Adrian, Frank C. Kaminsky, and Robert F. Rikkers.
Proc, Fourth Amer Water Resources Conf, NY, p 344-353, Nov 1968. 10 p, 2 fig, 9 ref.

Descriptors: *Systems analysis, *Waste water treatment, *Optimization, *Regional analysis, *Decision making, Planning, Mathematical models, Computers, Treatment facilities, Interception, Cost allocation, Water management (Applied).

The use of systems analysis to optimize regional planning for waste water systems was described. The objective of the study was to develop a methodology and mathematical-computer models which could aid planning agencies to make decisions concerning regional development. A region in Massachusetts was selected for the pilot application. A waste system was divided into the following subsystems; collection facilities, interceptors, various types of treatment plants, storage facilities and the stream. Engineering and economic data were used to describe and model each subsystem. Optimization techniques then helped define the most efficient configuration of subsystems for regions with differing characteristics. Attention was also given to procedures for implementing the plans and equitably allocating costs among communities. (Thiuri-Cornell)

W70-00898

RADIOTRACER STUDY OF RAPID SAND FILTRATION,

Georgia Inst. of Tech., Atlanta.

Thomas Fisher Craft, Jr.

Available from the Clearinghouse as PB-187 522, \$3.00 in paper copy, \$0.65 in microfiche. Water Resources Center, Georgia Institute of Technology, Partial Completion Report WRC-0469, August 1969. 179 p. OWRR Proj B-020-GA.

Descriptors: *Rapid sand filtration, *Porous media filter, *Drinking water treatment, *Radioactive tracers, *Filtering system, Cesium-137, Filter sands, Radioisotopes, Adsorption, Particle shape, Particle size, Pores, Porosity, Colloids, Flocculation.

The research was designed to investigate the mechanism by which suspended particles are removed from flowing water during passage through a porous medium. Particles labeled with radioactive Cesium-137 were suspended in water and passed into a laboratory scale filter built to simulate a commercial water filter. Radiation detection equipment was used to follow the radioactive particles. Three different sizes of sand and ground anthracite were used as filter media. The pattern of deposition was found to depend on the absolute and relative sizes of the suspended particles and the stationary grains. In a given filter medium, particle removal was found to vary directly with the particle diameter. For a given particle size, removal was found to vary inversely as the diameter of the filter bed grains. Interdependence of grain and suspended particle dimensions is such that the filter coefficient was found to vary inversely in a linear fashion with the ratio of pore diameter to particle diameter for ratios of about five or less. Additional work is needed to relate the ideal laboratory conditions to actual conditions encountered in the field. (Conway- Georgia Tech)

W70-00910

THE INFLUENCE OF SUSPENDED SOLIDS ON THE RATE OF OXYGEN TRANSFER IN AQUEOUS SOLUTIONS,

G. T. M. Van der Kroon.

Water Research, Vol 2, No 1, p 26-30, Jan 1968. 5 fig.

Descriptors: *Dissolved oxygen, *Oxygenation, *Respiration, *Suspended load, Solid wastes, Dissolved oxygen analyzers, Waste assimilative capacity, Activated sludge, Gases, Microorganisms, Clays, Laboratory tests.

Identifiers: *Oxygen transfer, *Holland, Rotterdam, River pollution, Sludge liquor.

The relationship between dissolved-oxygen content and the rate of respiration of microorganisms was studied in a mixed liquor from activated sludge plants and in Rotterdam tap water. The experimental apparatus allowed for a constant rate of gas flow and injection of oxygen when its partial pressure in the gas decreased. The oxygenation capacity and maximum rate of oxygen absorption were measured and the ratio between them was plotted against suspended solids concentration. It was concluded that the suspended solids concentration played an important role in the oxygen transfer in various solutions. The properties of clay and aluminum sulfate suspensions resembled those of a mixed liquor with respect to oxygen transfer. (Carstea-USGS)

W70-01023

MODIFIED FILTER MEDIA FROM REMOVAL OF WATER POLLUTANTS,

C. D. Agarwal, and A. V. S. Prabhakara Rao.

Water Research, Vol 2, No 1, p 43-45, Jan 1968. 6 ref.

Descriptors: *Water pollution treatment, *Filtration, *Water pollution control, *Filters, Sewage effluents, Electrolytes, Zeta potential, Bacteria, Protozoa, Algae, Solid wastes, Tertiary treatment.

Identifiers: Polyelectrolyte-coated filters, Bauxite.

A simple filter was developed for efficient removal of micronized particles. These particles include some bacteria, protozoa, algae, cysts, and even some worms. Sewage particles carry small electrokinetic charges (surface zeta potentials), which are generally negative. The efficiency of filtration can be greatly improved if the filter media are coated with cationic polyelectrolytes to retain the negatively charged particles. The experimental results obtained by using bauxite coated filters were comparable with those using polyelectrolytes. The economics of the designed criteria for this filtration progress are evaluated. (Carstea-USGS) W70-01027

STREAM REAERATION USING MOLECULAR OXYGEN,

For primary bibliographic entry see Field 05G.
W70-01028

AN EXAMINATION OF THE BENEFITS AND DISADVANTAGES WITH RESPECT TO THE DISPOSAL OF SOLID WASTES,

American Society of Civil Engineers, New York.

Donald H. Waller.

Available from Clearinghouse as PB-186 006 at \$3.00 in paper copy or \$0.65 in microfiche. ASCE Combined Sewer Separation Project, Technical Memorandum No 10, Feb 1, 1968. 54 p, 2 fig, 1 tab, 21 ref. FWPCA Program No 11020 EKO.

Descriptors: *Cost-benefit analysis, *Deposition (Solid wastes), *Sewage treatment, Pressure conduits, Sewers, Solid wastes.

Identifiers: Grinding, Solid waste characteristics, Transport velocity.

Important considerations in an evaluation of the feasibility and benefits of adapting any sewerage system to solid wastes disposal are: the extra solids load that community refuse could add to a sewage disposal system; velocities required to move solid wastes and the effect of flow variations on sewer velocities; solid wastes separation practices and attitudes toward separation of household refuse; the need for grinding, and considerations involved in the development of a household refuse grinding device; the effects of solid wastes on sewage treatment processes; and costs and benefits involved in evaluation of alternative systems for disposal of sewage and solid wastes. Considerations peculiar to the ASCE Project scheme are: the possibility of adapting building sewage storage-grinder-pump units for handling solid wastes; the need to discharge solid wastes into the system under pressure; reduced clearances in the small pipes of a pressure system; and the possibility of greater solids deposition at low flows. Appendices include information on: composition and characteristics of solid wastes; pertinent solid wastes research and development; and results of research on transport and treatment of solid wastes in sewage disposal systems. (Tucker-ASCE)

W70-01063

5E. Ultimate Disposal of Wastes

WASTEWATER DISPOSAL AND MICROBIAL ACTIVITY AT ICE-CAP FACILITIES,

Army Terrestrial Sciences Center, Hanover, N.H.
For primary bibliographic entry see Field 05C.
W70-00882

OIL FIELDS YIELD NEW DEEP-WELL DISPOSAL TECHNIQUE,

Halliburton Co., Duncan, Okla. Dept. of Chemical Research and Development.

K. A. Slagle, and J. M. Stogner.
Water and Sewage Works, Vol 116, No 6, p 238-244, June 1969. 7 p, 5 fig, 13 ref.

Descriptors: *Waste disposal, *Injection wells, Fractures (Geology), Permeability, Well casings, Monitoring, Oil industry, Geology, Waste treatment, Waste water disposal, Solid wastes.

Identifiers: *Well construction.

The predominant practice of injecting liquid wastes into permeable or naturally fractured subsurface strata is not the only method for the disposal of pollutants in deep wells. Utilizing other oil field operations such as hydraulic fracturing and other modifications may eliminate some common objections to this procedure—lack of suitable formations, expensive pre-injection equipment and treatment, and production of a secondary waste presenting in itself a disposal problem. Each particular waste disposal problem should be treated as a separate entity since the problems involved are so different throughout the various industries. A second waste disposal well, or a stand-by well, should be considered if the production of waste is such that general plant production may be interrupted or there is a possibility of discharging effluent into public streams or waters. A monitoring well system should be included to help detect or determine possible contamination or damage to fresh water aquifers and other minerals. Design of the well casing and equipment should be given serious consideration and the utmost in design precautions taken to provide maximum protection and longevity. Under normal low pressure disposal operation where naturally fractured formations are used, low pressure equipment may be utilized with pre-injection treatment facilities. (Knapp-USGS) W70-00990

5F. Water Treatment and Quality Alteration

A SYSTEMS APPROACH TO WASTE MANAGEMENT,

Massachusetts Univ., Amherst.

For primary bibliographic entry see Field 05D.
W70-00898

CAUSES AND CONSEQUENCES OF POND EUTROPHICATION (POLISH),

Polish Academy of Sciences, Krakow.

Stanislaw Wrobel.

English summary. Acta Hydrobiologica, Vol 7, No 1, p 27-52, 1965. 15 fig, 6 tab, 28 ref.

Descriptors: *Eutrophication, *Fertilization, *Nitrogen compounds, *Phosphorus compounds, *Thermal stratification, *Oxygenation, Organic matter, Respiration, Copper sulfate, Lime, Dissolved oxygen, Fish, Fish parasites, Water quality control, Water quality.

Identifiers: Fish respiration, Fish density, Carp culture, Branchiomyces sanguinus, Golysz Experimental Station (Poland), Water quantity, Water exchange, Oligotrophy, Polytrophy.

Results are reported of attempts to increase productive capacity of ponds by application of lime, and nitrogen- and phosphorus-fertilizers to encourage eutrophication, and by additions of copper sulfate to control excessive algal growth. Such management revealed a sequence of three trophic levels: oligotrophic, before fertilization; eutrophic, during fertilization; and polytrophic, during the intensive fish feeding. The latter phase induced periodic acute oxygen deficiency, endangering respiratory organs of fish and inviting the invasion of fish gills by Branchiomyces sanguinus. Maintenance of an adequate degree of water oxygenation requires control of organic matter content, occasional exchange of water of the pond, and a correlation of fertilization, feeding, and density of fish with the amount of inflowing water. (Wilde-Wisconsin) W70-01082

5G. Water Quality Control

NUCLEAR POWER PLANT SITING IN THE PACIFIC NORTHWEST FOR THE BONNEVILLE POWER ADMINISTRATION,

Battelle Memorial Inst., Richland, Wash. Pacific Northwest Labs.

For primary bibliographic entry see Field 05D.
W70-00883

WATER QUALITY AND REGIONAL ECONOMY, A DECISION MODEL,

Pennsylvania State Univ., University Park. Inst. for Research on Land and Water Resources.

David L. Raphael, and James Maugeri.

Proc, Fourth Amer Water Resources Conf, NY, p 132-139, Nov 1968. 8 p, 3 tab, 5 ref.

Descriptors: *Water quality, *Industrial water, *Decision making, *Leontief models, *Input-output analysis, *Pollution abatement, Water supply, Taxes, Waste water treatment, Economics, Regional analysis.

A Leontief input-output economic model was constructed to demonstrate how such a model could be utilized to bring rationality into regional decision making with respect to a specific water quality problem. Clinton County, located in Central Pennsylvania, was chosen for the study. The industry selected was a paper mill located in the county. It was assumed that the water quality was so poor that a substantial cost would be incurred by the industry in order to bring its quality to a usable level. It was also assumed that if the cost became prohibitive the industry would leave the county. Three alternatives were considered (1) closing the plant, (2) tax forgiveness, and (3) providing the plant with water of sufficient quality from local water utilities. It was concluded that (1) the penalty paid by the region by the closing of the mill was extremely large, (2) that the tax forgiveness amount could be passed along to the household sectors as a local tax increase thus returning the region to the status quo, and (3) that if the local utility could handle the increased needed supply at reduced income, the region would retain the mill and realize increased economic activity as well. (Thiuri-Cornell) W70-00897

LOWER MISSISSIPPI RIVER BASIN DEVELOPMENT DISTRICT.

For primary bibliographic entry see Field 04A.
W70-00912

THE CONSTITUTIONAL ASPECTS OF WATER POLLUTION AND THE NEED FOR GOVERNMENTAL COOPERATION,

Brian A. Stamp.

Agassiz Center for Water Studies Research Report, Univ of Manitoba, Vol 1, No 2, ch 7, 1968. 25 p, 42 ref.

Descriptors: *Water pollution control, *Water pollution, *Federal-state water rights conflicts, *Governments, Federal government, State governments, Natural resources, Political aspects, Water conservation, Water resources, Water supply, Jurisdiction, Federal jurisdiction, State jurisdiction, Water policy, Water quality, Water quality control, Impaired water quality, Public health, Administrative agencies, Fish management, Stream improvement, Navigable waters, Navigation, Legal aspects. Identifiers: *Canada.

In Canada, jurisdiction over water pollution is divided between the provincial and federal governments. Under the criminal law power, Parliament may enact criminal legislation aimed at pollution as a danger to public health, and it is also authorized to set up an administrative body to regulate pollution and to enforce such legislation. The general power under the peace, order, and good government clause would allow the federal government to cure existing pollution and to prevent such pollution in the future. Legislative jurisdiction over fisheries extends to controlling water quality that might affect fish. The navigation and trade and commerce powers are of limited significance in this respect. The provinces have authority in the field of pollution control since ownership of water is vested in the provinces and since the problems have a valid local aspect. The provinces are authorized to

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5G—Water Quality Control

set up needed physical works. Since the pollution problem has both federal and provincial aspects, it is logical that it be solved at both levels with legislative programs complementing one another. (Douglas-Florida)
W70-00915

STATUTORY STREAM POLLUTION CONTROL,

Seymour C. Wagner.
U Pa L Rev, Vol 100, No 2, p 225-241, Nov 1951.
17 p, 115 ref.

Descriptors: *Pennsylvania, *Pollution abatement, *Water pollution control, *Water pollution sources, Acid mine water, Bacteria, Coal mine wastes, Legislation, Legal aspects, Judicial decisions, State governments, Industrial wastes, Mine acids, Pollutants, Sewage effluents, Sewage treatment, Water pollution effects, Chemical wastes, Municipal wastes, Water pollution treatment, Water quality control, Water quality, Stream improvement, Economic feasibility.

Using the highly industrialized and populous state of Pennsylvania, this note discusses: (1) various legal methods available on pollution abatement; (2) problems which municipalities, industries and the public encounter in meeting pollution control obligations; (3) types of pollution and the necessity for treatment of pollutants as well as their prohibition; (4) the problem of coal related pollution; (5) failure of common-law and equity enforcement in pollution control; (6) the necessity of interstate and federal action; (7) the development of statutory pollution control; and (8) the financial burden of stream purification. The note also examines statutory enforcement in the areas of industrial wastes and municipal sanitation along with statutory remedies. It is concluded that conflicting economic interests, excessive financial burdens, and unsolved engineering problems must all be considered in long range pollution control. The task of water pollution control boards must be to advance programs by determining which interests have valid claims and by calling for legislative and judicial aid where needed. The case of Pennsylvania Coal Co. v. Sanderson, 6 Atl 453 (1886) is discussed. (Marsee-Florida)
W70-00923

STATUTORY STREAM POLLUTION CONTROL,

Seymour C. Wagner.
U Pa L Rev, Vol 100, No 2, p 225-230, Nov 1941.

Descriptors: *Pennsylvania, *Pollution abatement, *Water pollution control, *Pollutants, Water pollution sources, Bacteria, Acid mine water, Coal mine wastes, Legislation, Legal aspects, Judicial decisions, State governments, Municipal water, Cities, Industrial wastes, Mine acids, Sewage effluents, Sewage treatment, Water pollution effects, Chemical wastes, Municipal wastes, Water pollution treatment, Water quality control, Water quality, Water purification, Stream improvement.

The pollution of any one stream will consist of a varying combination of three basic types of pollution: physical pollution, chemical pollution, and bacterial pollution. Mere legal prohibition of pollution is not enough; the law must require treatment of pollutants before they enter streams. Common-law abatement measures have failed primarily because, unless the public has acquired rights for water supply or unless there is a statute involved, pollution is an injury of which only riparian owners may complain. Equity enforcement is also limited in that, by balancing the interests of the parties, the benefit to the plaintiff of abatement may be found disproportionate to the injury to the defendant's operations or interests. The public, acting through elected officials, stands a greater chance of obtaining equity enforcement than an individual, but there has been a failure to seek such enforcement. Not only have municipalities been lax in seeking protection from pollution, but they have them-

selves contributed a major share of contamination in the form of raw sewage. (Marsee-Florida)
W70-00924

STATUTORY STREAM POLLUTION CONTROL,

Seymour C. Wagner.
U Pa L Rev, Vol 100, No 2, p 230-236, Nov 1951.

Descriptors: *Pennsylvania, *Pollution abatement, *Water pollution control, *Acid mine water, Water pollution sources, Coal mine wastes, Legislation, Legal aspects, Judicial decisions, State governments, Industrial wastes, Mine acids, Pollutants, Sewage effluents, Sewage treatment, Water pollution effects, Chemical wastes, Municipal wastes, Water pollution treatment, Water quality control, Water quality, Stream improvement, Water purification.

The case of Pennsylvania Coal Co v Sanderson, 6 Atl 453 (1886), involved water pollution by the discharge of acid mine drainage. In denying relief for such injury, the case undoubtedly discouraged proponents of clean streams. The effect was to retard pollution abatement progress in all types of pollution situations; however, the case is doubtful authority in any field other than acid mine drainage. The inadequacy of common-law enforcement in preserving clean streams has led all but three states to adopt some sort of general statutory control to prevent pollution. While these statutes in general merely re-affirm common-law rights and obligations, they do create new methods of enforcement. Early statutory regulation of pollution in Pennsylvania was limited to the problem of sewage and contained many exceptions, including industrial wastes. The current statute also contains a general prohibition against the discharge of sewage; however, the Sanitary Water Board has been lax in its enforcement and interpretation. Current statutes concerning industrial wastes are more forceful, and the power of the Sanitary Water Board is not so all-inclusive. The greatest unsolved pollution problem today is that of mine drainage. (Marsee-Florida)
W70-00925

STATUTORY STREAM POLLUTION CONTROL,

Seymour C. Wagner.
U Pa L Rev, Vol 100, No 2, p 236-241, Nov 1951.

Descriptors: *Pennsylvania, *Pollution abatement, *Water pollution control, *Economic feasibility, Water pollution sources, Coal mine wastes, Legislation, Legal aspects, Judicial decisions, State governments, Federal government, Industrial wastes, Pollutants, Sewage effluents, Sewage treatment, Water pollution effects, Chemical wastes, Municipal wastes, Water pollution treatment, Water quality control, Water quality, Stream improvement.

Since the very remedies which proved ineffective at common law and equity are incorporated into the present water pollution act, the basis of the clean stream program in Pennsylvania must be the efficient employment of an administrative program. Just as common-law enforcement was lax, so a statutory program will fail unless efficiently implemented. Because rivers frequently constitute or cross state boundaries, interstate and federal enforcement action is needed. There is a growing tendency toward interstate agreements, and the federal government has recently taken an active interest in river pollution control. The most publicized aspect of the clean streams program in Pennsylvania has been the restoration of the Schuylkill River; however, the major economic problem lies not in reclamation but in financing the complex facilities needed to prevent untreated wastes from reaching rivers. Numerous financial burdens and problems must be faced, especially by municipalities, in establishing such systems. In the case of industry, state and federal aid is virtually non-existent. Water pollution control boards must

determine which interests have valid claims and call for legislative and judicial aid where needed. (Marsee-Florida)
W70-00926

WATER POLLUTION CONTROL AND ABATEMENT (BOOK REVIEW); CONTROLLING POLLUTION: THE ECONOMICS OF A CLEANER AMERICA (BOOK REVIEW),

Birch Bayh.
Notre Dame Lawyer, Vol 43, No 5, p 796-798, June 1968. 3 p, 2 ref.

Descriptors: *Air pollution, *Water pollution, *Pollution abatement, *Water pollution control, Water pollution effects, Water pollution sources, Water pollution treatment, Air pollution effects, Pollutant identification, Abatement, Air environment, Pollutants, Public health, Water allocation (Policy), Water resources, Water quality, Standards, Water, Economic feasibility, Economic impact, Economics, Benefits, Costs, Cost-benefit theory.
Identifiers: Book reviews.

Water Pollution Control and Abatement, edited by Ted L. Willrich and N. William Hines, advocates and has as its main thrust the premise that pollution control is a fundamentally local matter that requires effective interrelationship of three factors: (1) a sincere state commitment to clean waters manifested in a workable regulatory scheme; (2) knowledge and dedication on the part of state officials administering control programs; and (3) public understanding of the nature of the pollution problem and public support of control efforts. The book is a collection of essays. Controlling Pollution: The Economics of a Cleaner America, edited by Marshall I. Goldman, is a more specialized analysis concentrating primarily upon theoretical and practical problems faced by those who wish to approach solutions within the framework of costs and benefits. The underlying question is how an affluent society such as our own can best eliminate or control the serious consequences of pollutants. Writers of both books agree that the fundamental question of water quality control is whether a democratic, highly developed political system can discover and implement a formula which will allocate air and water resources equitably. (Marsee-Florida)
W70-00933

FISH POISONING; POISONING WATER SUPPLY.

Miss Code Ann secs 2326, 2328 (1956).

Descriptors: *Mississippi, *Poisons, *Public health, *Fish conservation, Mortality, Fish, Fishkill, Legislation, Reservoirs, Wells, Springs, Wildlife conservation, Fish management, Wildlife management, Water supply, Hazards, Fish toxins.

The use of any substance calculated and intended to stupefy or destroy fish shall be punishable as a misdemeanor. Any person who shall willfully poison any well, spring, or reservoir of water shall, upon conviction, be punished by imprisonment in the penitentiary not exceeding ten years. (Schram-Florida)
W70-00949

PAT HARRISON WATERWAY DISTRICT.

Miss Code Ann secs 5956-171 thru 5956-175, 5956-180, 5956-182 thru 5956-186, 5956-189 (Supp 1968).

Descriptors: *Mississippi, *Water districts, *Water policy, *Water conservation, Legislation, Construction, Irrigation water, Industrial water, Municipal water, Domestic water, Agriculture, Flood control, Pollution abatement, Taxes, Tax rate, Condemnation, Easements, Operating costs, Recreation, Right-of-way, Surface waters, Overflow, Fish conservation, Wildlife conservation, Water supply.

Water Quality Control—Group 5G

Authority is given to organize the Pat Harrison Waterway District to insure an adequate flood control program, provide a sufficient sanitary water supply, promote the balanced economic development of the state, and to aid in forest conservation, irrigation, and pollution abatement. All powers of the District are to be exercised by a Board of Directors. Procedures for creating the District through petitions, appointment of the directors, and organization of the Board are outlined. An extensive list of powers are granted to the District. Among these are the right to: (1) acquire land by purchase or condemnation; (2) overflow public lands; (3) impound surface or overflow water by constructing dams or reservoirs; (4) relocate highways, utilities, and railroads; and (5) develop plans and work with any federal or state agency. A series of limitations to the District's authority is included. The right to borrow money and issue bonds for the repayment thereof is granted. Taxing procedures are outlined and a special tax levy is provided for. Additionally, the Board of Directors is empowered to adopt all reasonable regulations to maintain sanitary water conditions, prevent waste, and regulate recreation. (Schram-Florida)
W70-00958

PAT HARRISON WATERWAY DISTRICT.
Miss Code Ann secs 5956-171 thru 5956-175
(Supp 1968).

Descriptors: *Mississippi, *Water districts, *Water policy, *Water conservation, Irrigation water, Industrial water, Municipal water, Domestic water, Recreation, Agriculture, Flood control, Pollution abatement, Water supply, Surface waters, Overflow, Forest management, Legislation, Optimum development plans, Water pollution, Construction.

Authority is given or organize the Pat Harrison Waterway District to conserve, utilize, develop, and regulate the overflow and surface waters so that their full beneficial use may be realized. This is deemed necessary to insure an adequate flood control program, provide a sufficient sanitary water supply, promote the balanced economic development of the state, and to aid in forest conservation, irrigation, and pollution abatement. The overflow waters for domestic, municipal, commercial, industrial, agricultural, and recreational uses are for the general welfare of the people of the state. All powers of the district shall be exercised by a Board of Directors. Provisions for the appointment of these directors, their compensation, term of office, and organization are detailed. The procedure for creation of the district through petitions is outlined. Hearings on such petitions and notice requirements are also dealt with. (Schram-Florida)
W70-00959

PAT HARRISON WATERWAY DISTRICT.
Miss Code Ann secs 5956-180, 5956-182 thru 5956-186, 5956-189 (Supp 1968).

Descriptors: *Mississippi, *Water districts, *Tax rate, *Water conservation, Fish conservation, Wildlife conservation, Taxes, Legislation, Assessments, Surface waters, Overflow, Water pollution, Pollution abatement, Condemnation, Right-of-way, Construction, Operating costs, Dams, Canals, Reservoirs, Recreation.

The powers of the district, through its Board of Directors, include the right to: (1) develop plans with any federal or state agency for public works; (2) impound overflow and surface water by constructing dams, reservoirs, or plants; (3) acquire by condemnation any needed property; (4) relocate highways, railroads, or any utility lines; (5) overflow any public lands; (6) construct any needed facility; (7) borrow money and issue bonds; (8) fix and collect charges for any services furnished; and (9) accept grants and exercise all other powers inherent in a corporate body. The power of taking land by purchase or condemnation is qualified, and the rights in such land which can be utilized are detailed. The district is authorized to establish parks and provide for fish and wildlife conserva-

tion. The Board of Directors has the power to adopt all reasonable regulations to maintain sanitary water conditions, prevent waste, and regulate recreation. Each county which is a member shall pay two mills of all ad valorem taxes due to the state to the district. A special tax levy, with bonds payable from ad valorem taxation, is provided. (Schram-Florida)
W70-00960

LOWER YAZOO RIVER BASIN DISTRICT.
For primary bibliographic entry see Field 04A
W70-00964

LOWER YAZOO RIVER BASIN DISTRICT.
For primary bibliographic entry see Field 04A.
W70-00965

LOWER YAZOO RIVER BASIN DISTRICT.
For primary bibliographic entry see Field 04A.
W70-00966

VILLAGE WATER SUPPLY INVESTIGATION, TERRITORY OF PAPUA AND NEW GUINEA,
Bureau of Mineral Resources, Geology and Geophysics, Canberra (Australia).
For primary bibliographic entry see Field 03B.
W70-00991

MODIFIED FILTER MEDIA FROM REMOVAL OF WATER POLLUTANTS,
For primary bibliographic entry see Field 05D.
W70-01027

STREAM REAERATION USING MOLECULAR OXYGEN,
H. R. Amberg.
Water Research, Vol 2, No 1, p 42-43, Jan 1968.

Descriptors: *Reaeration, *Dissolved oxygen, *Streams, Waste treatment, Oxygen sag, Diffusion, Water pollution treatment, Turbulence, Mixing, Dispersion, Pacific Northwest U. S.
Identifiers: *Stream reaeration, Molecular oxygen.

Drought flows and high water temperatures are usually associated with low dissolved oxygen levels in streams. An engineering method of stream reaeration using molecular oxygen instead of air is discussed as an economical alternative to conventional waste treatment. The solubility of molecular oxygen is 500% more than oxygen in equilibrium with air. The experimental work was conducted in a stream in the Pacific Northwest by using a power turbine. The oxygen was introduced at locations with relatively high dissolved oxygen concentration. In subsequent experiments, the molecular oxygen was introduced by using diffusers placed on the river bottom. It is possible to introduce large amounts of dissolved oxygen by using this method. Oxygen introduction is not limited, however, to the positions of the stream with high dissolved oxygen deficit, but may be located a reasonable distance upstream of the area in which it is needed. (Carstea-USGS)
W70-01028

COMPREHENSIVE WATER RESOURCES STUDIES ON THE ARA VALLEY AREA, JAPAN,
Akinori Sugiki.
Water Research, Vol 2, No 1, p 16-20, Jan 1968. 1 fig, 3 tab.

Descriptors: *Water resources development, *Water pollution control, Water pollution sources, Water demand, Water supply, Water management (Applied), Water conservation, Water resources, Water quality control.
Identifiers: *Ara Valley (Japan).

A system to control water pollution for the Ara Valley, Japan is discussed. The area is very heavily

populated and industrialized. Industrial and domestic sources of water pollution are estimated. Pollution loads will increase 7 to 8 times compared with the present load if the pollution is not controlled. The water demand for industrial and domestic uses was estimated to be about 48 million tons per day. Food, pulp, paper, and chemical industries should be forbidden in the area, whereas clothing industry, saw-mill and printing should be developed. These and other restrictions could reduce the estimated pollution load by 40%. Further research dealing with pollution load, techniques for pollution control and water consumption was recommended. (Carstea-USGS)
W70-01034

APPROACH TO DETERMINE THE MINIMUM ALLOWABLE FLOW IN THE TISZA RIVER, HUNGARY,
Bela Hock.

Water Research, Vol 2, No 1, p 13-16, Jan 1968. 2 fig, 2 tab.

Descriptors: *Water quality control, *Flow augmentation, *Oxygen requirements, River flow, Low-flow augmentation, Reservoir storage, Dam construction.

Identifiers: *Tisza River (Hungary), Water quality prediction.

The effects on water quality of a dam construction in the Tisza River, Hungary are predicted by determining the relationships between stream flow and water quality. Experiments were conducted between 1960 and 1965 to establish specific relationships between oxygen demand and stream flow in the Tisza River and its tributaries. The quality of water stored in the reservoirs of Tisza River Barrage No. II was slightly improved. The minimum water flow released from the reservoir was calculated so that the oxygen demand in the river should not exceed 10 mg/l. Two assumptions were made in this calculation: (1) the quality of water discharge from the reservoir was identical to that of incoming water; (2) the rate of organic matter decomposition was the same as in 1960. (Carstea-USGS)
W70-01035

ON THE DIFFUSION PHENOMENA IN BOUNDARY LAYERS OF TURBULENT FLOW AND ITS INFLUENCE ON THE COURSE OF THE SELF-PURIFICATION OF SMALL STREAMS,
For primary bibliographic entry see Field 05C.
W70-01037

THE WATER QUALITY PROTECTION PLAN. EFFICIENT MEANS TO ASSURE RATIONAL USE IN HYDROGRAPHIC BASINS (FRENCH),
For primary bibliographic entry see Field 05A.
W70-01038

FINAL REPORT TO THE AMERICAN SOCIETY OF CIVIL ENGINEERS ON TASK 7 AND TASK 9 OF THE COMBINED SEWER SEPARATION PROJECT,

American Society of Civil Engineers, New York.
For primary bibliographic entry see Field 08A.
W70-01043

DEVELOP AND FIELD TEST METHOD OF INSTALLING PRESSURE CONDUITS IN COMBINED SEWERS,

American Society of Civil Engineers, New York.
For primary bibliographic entry see Field 08A.
W70-01044

ANALYTICAL STUDIES OF TURBULENT FRICITION IN ANNULAR CONDUITS,

American Society of Civil Engineers, New York.
For primary bibliographic entry see Field 08B.
W70-01045

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5G—Water Quality Control

TURBULENT FRICTION IN ECCENTRIC ANULAR CONDUITS,
American Society of Civil Engineers, New York.
For primary bibliographic entry see Field 08B.
W70-01046

RELATIONSHIP OF SEWAGE CHARACTERISTICS TO CARRYING VELOCITY FOR PRESSURE SEWERS,
American Society of Civil Engineers, New York.
For primary bibliographic entry see Field 08B.
W70-01047

ADVANCED DEVELOPMENT OF HOUSEHOLD PUMP-STORAGE-GRINDER UNIT (TASK 6),
American Society of Civil Engineers, New York.
For primary bibliographic entry see Field 08C.
W70-01048

LONG-TERM OPERATION OF WASTEWATER OBSERVATION STATIONS (TASK 2),
American Society of Civil Engineers, New York.
For primary bibliographic entry see Field 08B.
W70-01049

REPORT ON PRESSURE SEWERAGE SYSTEM, SUMMER STREET SEPARATION STUDY AREA, BOSTON, MASSACHUSETTS,
American Society of Civil Engineers, New York; and Camp, Dresser and McKee, Boston, Mass.
For primary bibliographic entry see Field 08A.
W70-01051

COMBINED SEWER SEPARATION PROJECT, REPORT ON MILWAUKEE STUDY AREA.
American Society of Civil Engineers, New York; Greeley and Hansen, Chicago, Ill.
For primary bibliographic entry see Field 08A.
W70-01052

SEPARATION OF COMBINED WASTEWATER AND STORM DRAINAGE SYSTEMS, SAN FRANCISCO STUDY AREA.
Brown and Caldwell, San Francisco, Calif.
For primary bibliographic entry see Field 08A.
W70-01053

OUTLINE DESCRIPTION OF ASCE PROJECT ON 'SEPARATION OF SANITARY SEWAGE FROM COMBINED SYSTEMS OF SEWERAGE'.
American Society of Civil Engineers, New York.
For primary bibliographic entry see Field 08A.
W70-01054

SEWAGE FLOW VARIATIONS IN INDIVIDUAL HOMES,
American Society of Civil Engineers, New York.
For primary bibliographic entry see Field 08B.
W70-01055

EXPERIENCE WITH GRINDING AND PUMPING OF SEWAGE FROM BUILDINGS,
American Society of Civil Engineers, New York.
For primary bibliographic entry see Field 08C.
W70-01056

STUDY OF APPROXIMATE LENGTHS AND SIZES OF COMBINED SEWERS IN MAJOR METROPOLITAN CENTERS,
American Society of Civil Engineers, New York.
For primary bibliographic entry see Field 08A.
W70-01057

PRESSURE TUBING FIELD INVESTIGATION,
American Society of Civil Engineers, New York.
For primary bibliographic entry see Field 08A.
W70-01058

HYDRAULICS OF A PRESSURIZED SEWERAGE SYSTEM AND USE OF CENTRIFUGAL PUMPS,
American Society of Civil Engineers, New York.
For primary bibliographic entry see Field 08C.
W70-01059

MINIMUM TRANSPORT VELOCITY FOR PRESSURIZED SANITARY SEWERS,
American Society of Civil Engineers, New York.
For primary bibliographic entry see Field 08B.
W70-01060

DOMESTIC SEWAGE FLOW CRITERIA FOR EVALUATION OF PROJECT SCHEME TO ACTUAL COMBINED SEWER DRAINAGE AREAS,
American Society of Civil Engineers, New York.
For primary bibliographic entry see Field 08B.
W70-01061

PEAK FLOWS OF SEWAGE FROM INDIVIDUAL HOUSES,
American Society of Civil Engineers, New York.
For primary bibliographic entry see Field 08B.
W70-01062

CONTROL TECHNIQUES FOR PRESSURIZED SEWERAGE SYSTEMS,
American Society of Civil Engineers, New York.
For primary bibliographic entry see Field 08C.
W70-01064

NON-MECHANICAL CONSIDERATIONS INVOLVED IN IMPLEMENTING PRESSURIZED SEWERAGE SYSTEMS,
American Society of Civil Engineers, New York.
For primary bibliographic entry see Field 08A.
W70-01065

SPECIAL REQUIREMENTS FOR A FULL SCALE FIELD DEMONSTRATION OF THE ASCE COMBINED SEWER SEPARATION PROJECT SCHEME,
American Society of Civil Engineers, New York.
For primary bibliographic entry see Field 08A.
W70-01066

ROUTING OF FLOWS IN SANITARY SEWERAGE SYSTEMS,
American Society of Civil Engineers, New York.
For primary bibliographic entry see Field 08A.
W70-01067

DILUTION OF WASTE EFFLUENTS IN WATERS (IN RUSSIAN),
I. D. Rodziller.
Nauchnyie doklady po voprosam samootchishcheniya vodoyomov i smeshcheniya stochnykh vod, p. 25-38, Tallinn politecnic institute, Tallinn, ESSR, 1965.

Descriptors: *Water quality, *Waste dilution, Water pollution, Turbulence, Diffusion, Mass transfer, Stream pollution, Waste assimilative capacity, Water pollution effects, Mathematical models, Biochemical oxygen demand, Dissolved oxygen content, Water quality standards, Acidity.

A method of computation is presented which allows determination of (a) the distribution of Biochemical Oxygen Demand and Dissolved Oxygen below an effluent discharge into a stream including any number of effluent outfalls in both sides of the stream. The following equation was $L_{(oi)} = (L_{(o)} + A + B \cdot F) \cdot (10^{-K_p \cdot power})$ where $L_{(o)}$ is the BOD upstream of the effluent outfall, 'A' represents the sum of the effects of all effluent outfalls on the side where the main effluent outfall lies, and 'B' represents the same for the opposite side; (b) The distance below the effluent discharges where complete mixing takes

place was also determined by a formula; and (c) Effects of acids and bases on water quality are discussed, and formulas are presented for calculation of pH, acidity and alkalinity. (Novotny-Vanderbilt)
W70-01084

STATEMENTS OF POLICY ON PUBLIC WATER SUPPLY MATTERS--AMERICAN WATER WORKS ASS'N PRINCIPLES OF NATIONAL WATER POLICY.
Amer Water Works Ass'n J, Vol 61, No 10, Part 2, p 22-26, Oct 1969. 5 p.

Descriptors: *Water pollution, *Water policy, *Water pollution control, *Water resources development, Pollution abatement, Water users, Water treatment, Water storage, Low flow, Low flow augmentation, Federal government, State governments, Coordination, Planning, Organizations, Recreation, Water quality, Regulation, Water sources.

The American Water Works Association recommends a sound water resources policy based on planning and careful management. The responsibility for assuring water quality rests with those persons returning wastes to our resources. All government levels must act together in programs of pollution control and abatement and water resources data accumulation. The federal government should support state and local water programs rather than pre-empt them, except in cases where economic and planning complexities are beyond local capacity. A single state agency should be established in each state to provide a unified and coordinated water resources policy. Local public water suppliers should continue planning, financing, and operating systems for public and industrial users. The Association recognizes that as an interim measure it may be necessary to release water from storage for low flow augmentation rather than provide the high degree of waste treatment otherwise required. The Association opposes legislation permitting the opening of domestic water supply reservoirs to recreational use and urges control over waste discharges and land use affecting water sources. (McDonough-Florida)
W70-01130

BASIC WATER USE DOCTRINES AND STATE WATER CONTROL AGENCIES.
For primary bibliographic entry see Field 04A.
W70-01131

THE FEDERAL GOVERNMENT AND AIR AND WATER POLLUTION,
Paul E. Birmingham.
Bus Lawyer, Vol 23, No 2, p 467-481, Jan 1968. 15 p, 68 ref.

Descriptors: *Federal government, *Water pollution, *Water pollution control, *Federal jurisdiction, Regulation, Pollutants, Water supply, Recreation, Water quality control, Rivers and Harbors Act, Navigation, Treaties, Interstate rivers, Navigable waters, Cities, Legislation, Administrative agencies, Pollution abatement, Judicial decisions, Legal aspects, State jurisdiction, Effluents, Watercourses (Legal), Water pollution effects, Water pollution sources, Water pollution treatment, Standards.

Identifiers: *Water criteria, *Coastal waters, Injunctions (Prohibitory).

The author indicates that there is a four-step approach to pollution control: (1) water criteria which is an expression of the effect of various concentrations of pollutants depending on the intended use of body of water; (2) water quality standards which prescribe pollutant levels that cannot legally be exceeded; (3) effluent standards which prescribe the maximum amount of a specified pollutant that can be discharged from individual sources during specified time periods into specified waterways; and (4) control requirements which

WATER QUALITY MANAGEMENT AND PROTECTION—Field 05

Water Quality Control—Group 5G

regulate pollutant treatment before discharge. The history of pollution and the control role of the federal government are traced via federal legislation from the Rivers and Harbors Act of 1899 to the Federal Water Pollution Control Act of 1956. The 1956 Act gave each state until 1967 to adopt water quality standards for interstate waters within its borders. If a state did not comply, the Department of the Interior set the standards. The author points out how the federal government has extended its jurisdiction in the area of pollution control through expanding definitions of such terms as 'navigable waters', 'interstate waters', and 'coastal waters.' The questions of the constitutionality of the Act and abatement proceedings under the Act are briefly discussed. (Keith-Florida)
W70-01136

OFFENSES AGAINST PROPERTY BY FORCE.

For primary bibliographic entry see Field 06E.
W70-01149

OBSTRUCTION AND POLLUTION OF WATERS.

Miss Code Ann secs 2414, 2415 (1956), sec 2415.5 (Supp 1968).

Descriptors: *Mississippi, *Water pollution, *Water pollution control, *Obstruction to flow, Pollution abatement, Impaired water quality, Pollutants, Public health, Riparian rights, Standards, Wastes, Water conservation, Legislation, Sewage, Industrial wastes, Municipal wastes, Sewage disposal, Sewerage, Water pollution sources, Fish, Navigable waters, Navigation.

Any person who unreasonably obstructs any navigable waters or pollutes any such waters rendering them less fit for drink or for sustaining fish shall be guilty of a misdemeanor punishable by not more than a fifty dollar fine and/or imprisonment for thirty days. This shall not be construed to prevent any municipality from constructing sewers that empty into any navigable stream whose length is twenty-five miles or more. The State Board of Health, when public health requires, may prevent such emptying of sewerage or require steps to correct any evil that may exist. It is unlawful for any creosoting plant or any sawmill to dump wastage into any running stream. Any violation shall be deemed a misdemeanor punishable by a fine of not less than twenty-five dollars and not more than one hundred dollars for each offense. Each day that this section is violated shall constitute a separate offense. It is a misdemeanor for anyone to push, fell, or cut trees in excess of six inches in diameter into a running stream when such trees will materially impede the flow of or navigation upon such stream. (Schram-Florida)
W70-01151

GENERAL PROVISIONS OF THE STATE WATER CONTROL LAW.

Va Code Ann secs 62.1-14, 62.1-16 thru 62.1-18 (1968).

Descriptors: *Virginia, *Water quality, *Water quality control, *Water pollution control. Legislation, Legal aspects, Water control, Water law, Fish reproduction, Aquatic life, Fish conservation, Pollution abatement, Water rights, Permits, Wastes, Sewage, Recreation, Public health, Shellfish, Administration, State governments, Administrative agencies.

Identifiers: *Pollution prevention, *Waste discharge, *Public water uses, Public policy, Penalties (Criminal).

It is the policy of the state and the purpose of this chapter to: (1) maintain or restore all state waters to a condition of quality that will permit all reasonable public uses and support the propagation and growth of all aquatic life; (2) safeguard the clean waters of the state from pollution; (3) prevent any increase in pollution; and (4) reduce

existing pollution. No right to continue existing pollution in any state water will exist, nor will such right be or be deemed to have been acquired because of past or future pollution. The right and control of the state in and over all state waters is expressly reserved and reaffirmed. It is declared to be against public policy and a violation of this chapter for any owner who does not have a State Water Control Board certificate to discharge wastes or noxious or deleterious substances into state waters or to otherwise alter the physical, chemical, or biological properties of state waters so as to diminish the usefulness of such waters. This chapter is supplemental in nature and will not be construed to repeal existing law; the administration of existing pollution law will be in accord with the purposes of this chapter. (Keith-Florida)
W70-01169

POWERS AND DUTIES OF THE STATE WATER CONTROL BOARD.

Va Code Ann sec 62.1-27 (1968).

Descriptors: *Virginia, *Water quality control, *Water pollution control, *Water control, Legislation, Legal aspects, Administrative agencies, Water pollution, Regulation, Investigations, Pollution abatement, Water quality, Standards, Sewage, Industrial wastes, Permits, Fish, Water treatment, Pollutant identification, Damages, Operation and maintenance, Investigations.
Identifiers: *Pollution prevention.

The State Water Control Board has the duty and authority to (1) supervise the administration and enforcement of this chapter, and all standards, policies, regulations, and special orders promulgated thereunder; (2) study, investigate, and make recommendations concerning all state water pollution problems; (3) establish quality standards for waters in relation to the reasonable and necessary use thereof, and policies relating to pollution in keeping with the purposes of this chapter; (4) conduct scientific experiments, investigations, and research to discover economical and practical methods for preventing pollution; (5) issue certificates for the discharge of waste into state waters; (6) insure compliance with its certificates, standards, regulations, and special orders; (7) adopt administrative rules governing its procedure; (8) issue special orders to secure the control, abatement, and prevention of pollution; (9) adopt such regulations as it deems necessary to enforce the general pollution abatement program of the Board; (10) investigate any large scale killing of fish believed or known to have resulted from pollution, bringing a civil action against persons wilfully or negligently responsible for such killings; and (11) administer programs of financial assistance for state political subdivisions for the planning, construction, operation, and maintenance of water quality control facilities. (Keith-Florida)
W70-01170

REGULATION OF SEWAGE DISCHARGE.

Va Code Ann secs 62.1-31 thru 62.1-33 (1968).

Descriptors: *Virginia, *Sewage treatment, *Sewerage, *Sewage disposal, Sewers, Water pollution sources, Water pollution control, Waste disposal, Environmental sanitation, Sewage, Wastes, Governments, State governments, Legislation, Treatment, Administrative agencies, Cities, Regulation, Water quality control, Water pollution.

All sewerage systems and sewage treatment works are under the joint supervision of the State Department of Health and the State Water Control Board. The Department advises cities, towns, sanitary districts, and owners that intend to install sewage treatment works as to the appropriate type of treatment. Owners of treatment works from which sewage is discharged into state waters must furnish the Department, when requested by the Board, information regarding the operation of such facilities.

Owners presently discharging sewage into state waters may apply to the Board to continue to do so; however, the present volume and strength of the sewage may not be increased. The Board may not authorize any sewage discharge which would result in the pollution of clean state waters. All new sewerage systems or sewage treatment works designed to serve more than four hundred persons, or which will extend or alter materially such existing systems, must be approved by the Board. (Marsee-Florida)
W70-01171

PENALTIES FOR POLLUTION AND POLLUTION FROM BOATS.

Va Code Ann secs 62.1-43 thru 62.1-44.1 (1968).

Descriptors: *Virginia, *Sewage disposal, *Waste disposal, *Water pollution control, Water pollution sources, Disposal, Environmental sanitation, Sewage, Wastes, Governments, State governments, Legislation, Administrative agencies, Regulation, Legal aspects, Boats, Navigable waters, Non-navigable waters, Water quality control, Recreation wastes, Pollutants, Water pollution, Administration.

It is unlawful for any owner to cause pollution in state waters contrary to any special order adopted by the State Water Control Board. It is also unlawful to discharge sewage, industrial waste, or other wastes in violation of any condition contained in a sewage disposal certificate issued by the Board. Likewise unlawful is the failure or refusal to furnish information required by the Board. Penalties are herein provided. The Board promulgates regulations for the purpose of controlling the discharge of sewage and wastes from boats into navigable and non-navigable waters. In formulating such regulations, the Board consults with the State Department of Health, the Commission of Game and Inland Fisheries, and the Marine Resources Commission for the purpose of coordinating such rules. (Marsee-Florida)
W70-01172

INTERSTATE COMMISSION ON THE POTOMAC RIVER BASIN.

Va Code Ann secs 62.1-64 thru 62.1-69 (1968).

Descriptors: *Virginia, *Interstate commissions, *Interstate compacts, *Water pollution control, Water pollution, Water quality, Water quality control, Water resources, Interstate, Interstate rivers, Maryland, Pennsylvania, West Virginia, District of Columbia, River basins, Administrative agencies, Legislation, Governments, State governments, Federal government, Leadership, Financing, Coordination, Abatement.

The governor is authorized and requested to execute, on behalf of Virginia, a compact with Maryland, West Virginia, Pennsylvania, and the District of Columbia for the creation of the Potomac Valley Conservancy District. The purpose of such District is the abatement of existing pollution and the control of future pollution in interstate streams. The compact includes provisions for: (1) the creation of the Interstate Commission on the Potomac River Basin; (2) the powers of the Interstate Commission; (3) the financing of the Interstate Commission; and (4) the effective date of the compact. The Potomac River Basin Commission of Virginia is created subject to the execution of the above compact, and the appointment, terms, and qualifications of members are prescribed. The Potomac River Basin Commission of Virginia acts with and as a unit of the Interstate Commission and performs duties as provided by the compact. (Marsee-Florida)
W70-01173

OHIO RIVER VALLEY WATER SANITATION COMMISSION.

Va Code Ann secs 62.1-70 thru 62.1-72 (1968).

Field 05—WATER QUALITY MANAGEMENT AND PROTECTION

Group 5G—Water Quality Control

Descriptors: *Virginia, *Interstate commissions, *Interstate compacts, *Water pollution control, Water pollution, Water quality, Water quality control, Water resources, Interstate, Interstate rivers, River basins, Administrative agencies, Legislation, Governments, State governments, Federal government, Leadership financing, Coordination, Abatement, Ohio River.

The governor is requested to execute on behalf of Virginia, the Ohio River Valley Sanitation Compact. The purpose of the Compact is to abate existing and control future water pollution in the waters of the Ohio River Valley Basin. The terms and form of the Compact are set forth including: (1) the creation of the Ohio River Valley Water Sanitation District; (2) the creation of the Ohio River Valley Water Sanitation Commission; (3) the composition of the Commission and the selection of commissioners; and (4) the powers and duties of the Commission. It is recognized that no single standard for the treatment of sewage or industrial wastes is applicable in all parts of the district; therefore, the guiding principle of this compact shall be that pollution within a signatory state shall not injuriously affect the various uses of interstate waters. All sewage and industrial wastes entering interstate waters must be treated to the extent necessary to maintain such waters in a sanitary condition at least equal to the condition of the interstate waters immediately above the confluence. The Commission shall recommend uniform water pollution legislation to the signatory states. (Marsee-Florida)
W70-01174

DREDGING SAND AND GRAVEL AND MISCELLANEOUS OFFENSES (WATER POLLUTION)

Va Code Ann secs 62.1-190 thru 62.1-196 (1968).

Descriptors: *Virginia, *Riparian rights, *Dredging, *Water pollution, Pollutants, Water conservation, Fouling, Sands, Gravels, Beaches, Streambeds, Ownership of beds, Navigable waters, Low water mark, Tidal water, High water mark, Oil, Oil wastes, Impaired water quality, Obstruction to flow, Public health, Water pollution sources, Federal government.

Identifiers: Injunctions (Prohibitory), Penalties (Criminal), Penalties (Civil), Dumping garbage.

Dredging of sand or gravel from any part of the fastland, beach, or bluff abutting any river, stream, or other waters within the jurisdiction of the state or from the beds thereof is prohibited. Any person or corporation violating these provisions is guilty of a misdemeanor. The owner of any such fastland, beach, bluff, or bed of stream on which such a deposit exists may obtain an injunction to prohibit such dredging and may recover treble damages for any material removed. These prohibitions do not apply to the owners of such deposits, their licensees, or licensees of the United States. It is unlawful to obstruct or contaminate state waters by dumping garbage or any other substance which may impair the lawful use or enjoyment of them. Any obstruction which exists for more than a week, except a lawfully constructed dam, is prohibited. Contamination or obstruction of certain areas is specifically prohibited. Oil may not be discharged upon or under the navigable tidal waters of the state. Persons renting boats are required to provide a life preserver for each passenger. (Schram-Florida)
W70-01181

NEW ENGLAND INTERSTATE WATER POLLUTION CONTROL COMMISSION.

R I Gen Laws Ann secs 46-16-1, 46-16-2 (1956).

Descriptors: *Rhode Island, *Interstate compacts, *Water pollution control, *New England Interstate WPS Compact, New England, Pollution abatement, Water quality control, Interstate, Interstate commissions, Interstate rivers, Water pollution treatment, Control, Industrial wastes, Standards, Administrative agencies, Financing, Costs, Cost allocation, Cost sharing, Sewage, Regulation.

Identifiers: *Interstate waters.

The Commission on Interstate Cooperation is directed to negotiate with Maine, New Hampshire, Vermont, Massachusetts, and Connecticut the New England Interstate Water Pollution Control Compact. The Compact is to abate existing and control future pollution in the interstate waters of the New England area. Toward this end the New England Interstate Water Pollution Control Commission is created. The membership of the Commission and the procedure for the selection of commissioners is herein set forth along with various powers and duties of the Commission. The Compact recognizes that no single standard of sewage and waste treatment and no single standard of quality of receiving waters is practical. The degree of treatment of sewage and industrial wastes should take into account the classification of the receiving waters according to present and proposed highest use. The Commission is to establish physical, chemical, and bacteriological standards of water quality satisfactory for various classifications of use. Each state will prepare a classification of its interstate waters, and the Commission may make such changes in definitions, classifications, or standards as are necessary for uniformity. Distribution of costs among the signatory states is provided. (Marsee-Florida)
W70-01191

OXYGEN MANAGEMENT AND ARTIFICIAL REAERATION IN THE AREA OF BALDENNEY LAKE AND THE LOWER RUHR RIVER (IN GERMAN),

Ruhrverband, Essen (West Germany).

Klaus R. Imhoff.

English summary. Das Gas- und Wasserfach, 109 Jahrg (1968), Heft 34, Seite 936-941 (Wasser-Abwasser).

Descriptors: *Pollution control, *Aeration, *Optimization, Water pollution, Dissolved oxygen, Biochemical oxygen demand, Costs, Oxygenation. Identifiers: *Instream aeration, Diffuser aerator, Mechanical Aerator, Hydraulic turbine aerator.

The Ruhr River in Germany has presented a major pollution control problem for a long time. Although only a small river, the equivalent of sewage from over 2 million population comes through the central area near the city of Essen. In addition to very strict control of effluents by waste treatment plants, the pollution control agency, the Ruhrverband, has applied instream aeration as a supplemental means. Three aeration methods have been used—by introducing air into hydraulic turbines, by diffusers (bubbling from submerged orifices), and by mechanical aerators. Technical analysis allows an economic comparison as follows. In order to remove organic pollution of one population equivalent, at times of low flow, the cost would amount to 0.81 DM for a mechanical aerator, and 0.22 DM with the turbine aerator, as compared to 4.0 DM for expansion of the treatment plant to achieve the same result. Other figures show the diffuser as much less economic than the mechanical aerator, though part of the extra cost is due to certain special circumstances. This result is in accord with recent American findings that instream aeration is an economical means in severe pollution situations. (Whipple-Rutgers)
W70-01224

06. WATER RESOURCES PLANNING

6A. Techniques of Planning

APPLICATION OF DYNAMIC PROGRAMMING TO THE CONTROL OF WATER RESOURCES SYSTEMS,

Stanford Research Inst., Menlo Park, Calif.

Robert E. Larson, and William G. Keckler.

IFAC, Haifa Symp, Comput Contr Nat Resources Publ Util, p 1-52, Sept 1967. 52 p, 11 fig, 6 tab, 12 ref.

Descriptors: *Dynamic programming, *Water resources development, *Optimization, *Planning, Stochastic processes, Reservoir operation, Approximation method, Hydroelectric power, Irrigation efficiency, Investment, Water demand, Water storage, Control systems.

The applicability of dynamic programming techniques for solving optimization problems that occur in the operation and planning of a water system was examined. Several specialized dynamic programming techniques were introduced. These included forward dynamic programming, successive approximations dynamic programming for stochastic control, iteration in policy space and state increment dynamic programming. Four examples were presented and discussed. Short term optimization of a two reservoir system was solved with the forward dynamic process, short term optimization of a four reservoir system was treated by successive approximations; optimum operation over a year, with streamflows treated as stochastic variables, was determined by iteration in policy space, and optimum long term planning of system additions was treated by forward dynamic programming. Dynamic programming was found to be suitable for solving a wide range of water resource problems extending from hourly control of a system involving hydroelectric power, water storage and irrigation, to a long range optimum investment planning. (Thiuri-Cornell)
W70-00903

VALUATION OF A GROUNDWATER SUPPLY FOR MANAGEMENT AND DEVELOPMENT,

Nevada Univ., Reno. Desert Research Inst.

For primary bibliographic entry see Field 04B.

W70-00904

STORAGE YIELD: EXTENDING THE SEQUENT PEAK ALGORITHM TO MULTIPLE RESERVOIRS,

Water Resources Engineers, Inc., Springfield, Va.

G. K. Young, and C. D. Puentes.

Work sponsored by Texas Water Develop Board and Dept of Interior, (OWRR). Water Resources Res, Vol 5, No 5, p 1110-1114, Oct 1969. 5 p, 2 fig, 5 ref. OWRR Grant No 14-01-0001-1975.

Descriptors: *Mathematical studies, *Reservoir storage, *Reservoir design, *Reservoir operation, Reservoir yield, Computer programs, Streamflow, Reservoir construction, Systems analysis.

Identifiers: *Sequent peak algorithm, Multiple-reservoir systems.

The sequent peak algorithm is extended to find volume requirements as a function of time. These requirements are helpful in determining reservoir construction timing in multiple-reservoir systems. The principal variable used in the algorithm characterizes a reservoir storage history which is unfounded by volume limits. (Knapp-USGS)
W70-01000

STOCHASTIC METHODS FOR ANALYZING RIVER BASIN SYSTEMS,

Cornell Univ., Ithaca, N.Y. Dept. of Water Resources Engineering.

Daniel P. Loucks.

Available from the Clearinghouse as PB-187 686, \$3.00 in paper copy, \$0.65 in microfiche. Research Project Technical Completion Report, Water Resources and Marine Sciences Center, Aug, 1969. 306 p, 39 ref. OWRR Project C-1034.

Descriptors: *Stochastic processes, *Analytical techniques, *River basins, *Linear programming, *Dynamic programming, *Reservoir operation, Simulation analysis, Optimization, Delaware River, Water quality control, Water resources development, Multi-purpose reservoirs.

Identifiers: Targets, Operating policies.

A variety of stochastic linear, nonlinear and dynamic programming methods are presented for the preliminary selection of alternative water

Evaluation Process—Group 6B

resource system designs and operating policies. Emphasized is the influence of hydrologic risk on water resource planning. The optimism inherent in the results of most river basin system analyses that do not explicitly consider at least some of the variability of streamflow is illustrated through numerous applications of the models to both simple and complex examples. Three types of stochastic models are compared for defining sequential operating policies for a multipurpose reservoir. In situations where capacities and targets are not variables, dynamic programming is shown to be a very efficient method for defining operating policies. Water quality (DO, BOD) control by wastewater treatment and flow augmentation is examined from a regional multi-objective viewpoint. A detailed optimization-simulation study of the Delaware River basin illustrates the efficiency of both deterministic and stochastic optimization models for use in the preliminary selection of design and operating alternatives for further analysis by simulation.

W70-01085

GENERAL SYSTEMS APPROACH TO GROUND-WATER PROBLEMS,
Arizona, Tucson.
For primary bibliographic entry see Field 02F.

W70-01123

6B. Evaluation Process

EVALUATION OF BENEFITS OF A FLOOD WARNING SYSTEM,
Carnegie-Mellon Univ., Pittsburgh, Pa.; Systems Planning Associates, Pittsburgh, Pa.; and Weather Bureau, Pittsburgh, Pa.
H. J. Day, G. Bugliarello, P. H. P. Ho, and V. T. Houghton.
Water Resources Res, Vol 5, No 5, p 937-946, Oct 1969. 10 p 7 fig, 3 tab, 15 ref.

Descriptors: *Flood protection, *Non-structural alternatives, *Cost-benefit analysis, *Warning systems, Flood damage, Cost analysis, Flood plain zoning, Flood proofing.
Identifiers: Flood warning systems.

Benefits due to a flood warning system are estimated by using individual structure stage damage curves for several warning periods. Typical stage damage warning time data for residence, a grocery supermarket, and a railroad switchyard serve as examples for benefit evaluation. The application of these concepts to 650 residences involved in the 1959 flood at Meadville, Pennsylvania, indicated that reducible damages represent approximately one-third of the total residential damage. Both evacuation and temporary floodproofing, two non-structural alternatives used frequently, may be evaluated more explicitly by this method. (Knapp-USGS)

W70-00838

PRIVATE WATER RIGHTS IN FRANCE AND IN THE EASTERN UNITED STATES,
Ludwik A. Teclaff.
Am J Comp L, Vol 11, No 4, p 560-573, Autumn 1962. 14 p, 40 ref.

Descriptors: *Riparian rights, *Prior appropriation, *Reasonable use, *Legal aspects, Surface waters, Streams, Civil law, Navigable waters, Ownership of beds, Riparian land, Water law, Industrial water, History, Public rights, Non-navigable waters, Foreign waters, Underground streams, Subsurface waters, Water rights, Competing uses, Foreign countries, Water demand, Water supply.
Identifiers: *Common law, Foreign water law, Eastern United States.

The history of water law and the development of the three distinct theories of riparian rights, prior appropriation, and administrative appropriation are briefly reviewed. Despite differing legal heritages, both France and the Eastern United

States adopted the riparian theory. Both recognize different forms of water - stream, underground, and surface - and attach specific rights to each. These areas are discussed and water rights in respect to each area are compared. The discussion of streams comprehensively covers: (1) public streams; (2) non-public streams; (3) riparian land; (4) riparian rights; (5) industrial uses; (6) police power of the state; and (7) other characteristics of riparian rights. Similarities and differences in these areas are illustrated through reference to both statutory and case law. The author concludes that the quantity of available water was responsible for adherence to the riparian theory, and an equitable working of the system was provided through checks and balances involving reasonable use. Imminent water shortages, brought about by industrial use, seem to require more administrative control in each country. (Schram-Florida)
W70-00916

PRIVATE WATER RIGHTS IN FRANCE AND IN THE EASTERN UNITED STATES,
Ludwik A. Teclaff.
Am J Comp L, Vol 11, No 4, p 560-564, Autumn 1962. 5 p, 15 ref.

Descriptors: *Riparian rights, *Prior appropriation, *Navigable waters, *Non-navigable waters, Ownership of beds, Streams, Civil law, History, Public rights, Foreign waters, Foreign countries, Legal aspects, Water law, Beds, Stream beds, Administration, Interstate rivers, Underground Streams, Surface waters.

Identifiers: *Common law, Foreign water law, France.

By the 19th century, water law had begun to crystallize into three distinct types: (a) riparian rights, limiting the right of water use to the owners of adjacent lands; (b) prior appropriation, giving this right to the first user; and (c) administrative apportionment, placing the disposition of water in the hands of the government. None of these doctrines is peculiar to either common law or to civil law. The most important factor in adopting one type of law is the quantity of water available. Both France and the Eastern United States adhere to the riparian rights doctrine. Major changes in French water law have been made by statutes. In the United States, water law has developed primarily through judicial decisions. Both France and the United States use navigability to determine whether streams are public or subject to private ownership. In France, public ownership is determined today by administrative enumeration while American courts generally still use the navigability test. Riparian owners in France have the same right to public streams as the general public, but in the United States such rights are only subject to the rights of the public and of navigation. Under both systems ownership of beds of non-public streams is accorded to the riparians. (Schram-Florida)
W70-00917

PRIVATE WATER RIGHTS IN FRANCE AND IN THE EASTERN UNITED STATES,
Ludwik A. Teclaff.
Am J Comp L, Vol 11, No 4, p 564-569, Autumn 1962. 6 p, 17 ref.

Descriptors: *Riparian rights, *Riparian land, *Natural flow doctrine, *Reasonable use, Industrial water, Hydroelectric power, Remedies, Relative rights, Obstruction to flow, Mill dams, History, Public rights, Non-navigable waters, Navigable waters, Competing uses, Legal aspects, Water law, Ownership of beds, Usufructuary right.

The water of non-public streams is not subject to ownership, hence owners of riparian land have only limited rights to it. In both countries, land must touch the stream at some point to be classified as riparian. In other respects, the French and American systems differ considerably in their definition of riparian land. In relation to riparian rights, American jurisdictions utilize either the natural

flow doctrine or reasonable use theory. The French system resembles more the doctrine of reasonable use since no hierarchy of uses is established. French and American riparian rights differ in the treatment of non-navigable streams as sources of power. In France, the administration may award licenses to non-riparians on payment of compensation to dispossessed riparian owners. Riparian rights in both countries are limited by the police power of the state. In France this is vested in the administration. In the United States, the Federal Constitution poses the problem of states limiting property rights for the public welfare. It appears that the states have ample latitude in this field. Riparian rights are protected in France by possessory action and in the United States by action for damages and injunction. (Schram-Florida)
W70-00918

PRIVATE WATER RIGHTS IN FRANCE AND IN THE EASTERN UNITED STATES,

Ludwik A. Teclaff.
Am J Comp L, Vol 11, No 4, p 569-573, Autumn 1962. 5 p, 8 ref.

Descriptors: *Underground streams, *Percolating water, *Surface waters, *Water rights, Confined water, Riparian rights, Subsurface waters, Beneficial use, Domestic water, Industrial water, Irrigation water, Prior appropriation, Reasonable use, Natural flow doctrine, Remedies, Prescriptive rights, Riparian waters, Water law.
Identifiers: *Common law.

French law makes no distinction between the various forms of underground water. In the United States underground streams flowing in a definite channel are distinguished from the various forms of percolating water. In the United States the reasonable use theory is replacing the common-law notion that the owner of the overlying land had full ownership of the underground water. The French law is similar to the laws of those states that follow the common-law rules, mitigated by the exclusion of malicious uses. Both systems give the landowner full ownership of surface waters. In the United States, such water is treated as part of the land, whereas in France it becomes an object of ownership only upon capture. French water law and its counterpart in the eastern United States developed in regions where water is comparatively abundant. As long as the water was used mainly for domestic purposes and for irrigation, the riparian system worked well. But it proved inadequate when industrial uses of water began. In both countries development seems to point in the same direction—toward more administrative control. (Schram-Florida)
W70-00919

NOTES ON WATER WORKS LAW SECOND INSTALLMENT - IRRIGATION AND RIPARIAN RIGHTS,

John H. Murdock, Jr.
Water and Sewage Wks, Vol 102, No 1, p 12-18, Jan 1955. 7 p.

Descriptors: *Irrigation, *Riparian rights, *Legal aspects, *Reasonable use, Alteration of flow, Artificial use, Natural use, Competing uses, Natural flow doctrine, Obstruction to flow, Relative rights, Remedies, Riparian land, Riparian waters, Usufructuary right, Water law, Water utilization, Judicial decisions, Streams, Rivers, Irrigation water, Water rights, Water supply.

Irrigation may cause a threat to public water supplies. The downstream riparian owner has a right to the unimpeded flow of the stream, while the upland riparian owner has the right to reasonable use of the water. Court decisions have recognized the right to use the water for irrigation if the use is not unreasonable. The criteria is whether the water flowing to the lower owner's land has been materially diminished. Several cases have held that where the water supply is not sufficient to provide for competing natural riparian uses and also irrigation,

Field 06—WATER RESOURCES PLANNING

Group 6B—Evaluation Process

then irrigation would be an unreasonable use. The common law rule is that water may not be diverted to irrigate non-riparian land because this is not a riparian right. The size of the stream involved will be very relevant to the issue of whether irrigation is a reasonable use. Once a right to irrigate is established as reasonable it may only be stopped by the acquisition of the riparian right itself. Eminent domain may be used to acquire such a right if it is required for the public water supply. Unreasonable diversions may be enjoined. (Darragh-Florida)
W70-00920

REAL PROPERTY—RIPARIAN GRANTS—LEGISLATIVE LIMITATIONS ON EXTENT OF GRANT.

Rutgers L Rev, Vol 10, No 4, p 738-741, Summer 1956. 4 p.

Descriptors: *New Jersey, *Tidal waters, *Administrative agencies, *Ownership of beds, Bulkhead line, Legislation, Judicial decisions, Bays, Riparian land, Land tenure, Equitable apportionment, Legal aspects, Water zoning, Administration, Competing uses, Water allocation (Policy), Regulation, Zoning, Beds, Land, Landfills, Land forming, Piers, Bulkheads, Structures.
Identifiers: *Submerged Land Grants.

Bailey v Driscoll, 19 NJ 363, 117 A2d 165 (1955), which involved the grant of lands formerly under Barnegat Bay, presents the problem of determining the limitations placed by the New Jersey legislature upon the extent of such grants. Enactments concerning riparian grants of submerged and formerly submerged lands are in a confused state because of such grants' piecemeal enactment. One series of acts limits grants to 'exterior lines', apparently meaning bulkhead or pier lines beyond which it is unlawful to erect and maintain any structure. Another series of acts, by 'exterior lines', appears to mean a demarcation line beyond which there can be no obstruction of navigation. Also, by virtue of these acts, the Council of the Division of Planning and Development is simultaneously limited to exterior lines in granting lands and given the power to establish such lines. The Supreme Court properly held in the instant case that the Council could grant lands to the extent of the established exterior lines. How far outward into the water exterior lines may be established was not decided, although it appears from the statutes that such lines shall not interfere with public navigation. (Marsee-Florida)
W70-00927

GOVERNMENTAL TECHNIQUES FOR THE CONSERVATION AND UTILIZATION OF WATER RESOURCES: AN ANALYSIS AND PROPOSAL.

Yale L J, Vol 56, No 2, p 276-303, Jan 1947. 28 p, 125 ref.

Descriptors: *Water resources development, *Water conservation, Water utilization, *Federal government, Federal-state water rights conflicts, Watersheds (Basins), State governments, Interstate commissions, Interstate compacts, Interstate rivers, River basins, Drainage, Watershed management, Port Authority of New York, Tennessee Valley Authority Project, Administrative agencies, Legislation, Water control.
Identifiers: Regional drainage projects.

The scarcity of water in the arid and semi-arid regions of the United States, coupled with the interstate character of drainage basin problems, has produced a demand for effective federal-state water control and regional development. Federal administrative techniques have led to the dispersal of water problems among different departments leading to jurisdictional disputes and duplication of functions. Interstate compacts are also inhibited by jurisdictional disputes, state constitutional limitations, lack of funding, and lack of coercive authority. The success of the Tennessee Valley Authority

and the Port of New York Authority illustrates that proper delegation of federal and state power can be effectively merged. The nation requires a national corporation created by Congress and the negotiation of interstate compacts delegating important state powers over water resources to the corporation. The corporation will operate on a regional basis cooperating with and coordinating federal and state authority to develop an effective drainage basin program. (McDonough-Florida)
W70-00934

GOVERNMENTAL TECHNIQUES FOR THE CONSERVATION AND UTILIZATION OF WATER RESOURCES: AN ANALYSIS AND PROPOSAL.

Yale L J, Vol 56, No 2, p 276-288, Jan 1947.

Descriptors: *Water resources development, *Watersheds (Basins), *River basin development, *Administrative agencies, Tennessee Valley Authority Project, Interstate rivers, Interstate commissions, State jurisdiction, Federal jurisdiction, Legislation, Watershed management, Water rights, Water utilization, Regulation, Federal government. Identifiers: Regional drainage projects.

The effective regulation and development of a river basin area is inhibited by the interstate character of the basin drainage problem. Traditionally the Supreme Court has acted as the arbiter of interstate water disputes on a case by case basis. The federal government utilizes the war power, treaty power, and the commerce clause for national programs for navigation improvement, flood control, and power production. Administration of national policy is further divided among the departments of Agriculture, Interior, State, and Treasury in divergent water control activities. The absence of an organizational pattern of nation-wide machinery for coordinating plans has led to duplication of functions and jurisdictional disputes within departments. One method to escape this federal compartmentalizing of responsibility has been the Congressional creation of regional valley authorities. The success of the Tennessee Valley Authority as a single governmental agency of all federal authority and responsibility provides a working model. The Authority depends on state cooperation through permissive legislation and modification of existing doctrines of water rights to comply with federal plans. (McDonough-Florida)
W70-00935

GOVERNMENTAL TECHNIQUES FOR THE CONSERVATION AND UTILIZATION OF WATER RESOURCES: AN ANALYSIS AND PROPOSAL.

Yale L J, Vol 56, No 2, p 289-303, Jan 1947.

Descriptors: *Water resources development, *Federal-state water rights conflicts, *River basin development, *Watersheds (Basins), Interstate commissions, Interstate compacts, Legislation, Administrative agencies, Federal jurisdiction, State jurisdiction, Watershed management, Interstate rivers, Drainage, Federal government, Projects.
Identifiers: Regional drainage projects.

Many states fear federal encroachment by consenting to regional authorities and prefer to use interstate planning commissions, interstate compacts, and interstate public authorities. The interstate planning commission lacks coercive authority, funds, and may be foiled by the recalcitrance of a single state. Interstate compacts have the inherent limitations of federal and state constitutions and stress political compromise over effective water planning. The interstate public authorities closely resemble the regional valley concept in that the states agree to vest authority into one corporate body for continuous administrative supervision. This system is subject to the veto by the governor of each participating state, and all new major projects must be authorized by the state

legislatures involved. The solution is the creation by Congress of a national corporation and the negotiation of interstate compacts giving the corporation a delegation of important state powers over water resources. The fusion of national and local power into a single agency and the passing of state enabling legislation will provide an effective means of solving the problem of river basin drainage. (McDonough-Florida)
W70-00936

CANALS AND WATERWAYS (UPPER MISSISSIPPI RIVERWAY COMPACT).

III Ann Stat ch 14, sec 1101, art V, 'Powers', (Smith-Hurd Supp 1969).

Descriptors: *Illinois, *Water resources planning, *Interstate commissions, *Interstate compacts, Mississippi River, Administrative agencies, Legislation, Regulation, Public benefit, Water resources, Natural resources, Land resources, Administration, State governments, Management, Water policy, Parks, Recreation, River basin development, Water resources development, Water pollution, Water quality control, Erosion control, Planning, Diversions.

The Upper Mississippi Riverway Compact, which establishes the Upper Mississippi Riverway District and the Upper Mississippi Riverway Commission, confers certain powers on the Commission. These include the power to conduct studies and develop recommendations for the present and future protection, use, and development in the public interest of the river valleys and waters in, adjacent to, and affecting the Upper Mississippi Riverway District with respect to: (1) joint regional planning for the development of such areas; (2) measures for controlling water pollution, maintaining water quality, and controlling water use; (3) programs for control of soil and river-bank erosion and the general improvement of the river basins; and (4) diversion of waters to and from the rivers. The Commission and its properties are not subject to taxation. The Commission may provide coordinated services to two or more parks and may open its facilities to the public. The Commission must submit a budget to the appropriate state officer and may not pledge the credit of any party state. The Commission may regulate land and water resources. Nothing in the Compact limits the jurisdiction of any party state or federal government. A party state may withdraw from the Compact by payment of fair value and reacquire all real property located within the state. (Moulder-Florida)
W70-00939

TOMBIGBEE - TENNESSEE WATERWAY DEVELOPMENT COMPACT.

Miss Code Ann secs 5956-45 thru 5956-48 (Supp 1968).

Descriptors: *Mississippi, *Interstate compacts, *Interstate rivers, *Interstate commissions, Cooperatives, Governments, State governments, Water policy, Water resources development, Tennessee River, Alabama, Kentucky, Tennessee, Florida, Rivers, Channels, Construction, Administrative agencies, Federal government, Legislation, Planning, Navigation, Coordination, Navigable waters.

The compact's purpose is to promote the development of a navigable waterway connecting the Tennessee and Tombigbee rivers so as to provide a navigable channel and create a joint interstate authority between Alabama and Mississippi. The party states shall create the Tennessee-Tombigbee Waterway Development Authority, the purpose of which is the promotion and coordination of said waterway. The Authority is empowered to hold hearings, conduct studies and surveys, acquire necessary land, cooperate with all concerned groups or agencies, coordinate representation and support in Congress, and exercise all powers appropriate to these purposes. Financial contribu-

Evaluation Process—Group 6B

tions of each party state are in the proportion its population bears to the total population of all party states. Tennessee, Kentucky, and Florida are admitted as party states. (Darragh-Florida)
W70-00945

A PHYSICAL AND ECONOMIC ANALYSIS OF ALTERNATIVE IRRIGATION METHODS IN A SUB-HUMID CLIMATE,
North Dakota State Univ., Fargo.
For primary bibliographic entry see Field 03F.
W70-01086

POLLUTION--CAUSES, COSTS, CONTROLS.

Chem Eng News, p 33-68, June, 1969. 18 p, 13 fig.

Descriptors: Air environment, *Air pollution, *Atmospheric pollution, Manufacturing, Environment, Environmental sanitation, Wastes, Industrial wastes, Contamination, Waste treatment, Waste water (Pollution), *Water pollution, Water quality, Water quality act, *Water pollution control, Water pollution sources, Costs, *Pollution abatement, Legislation.

Identifiers: *Air pollution control, Exhaust gases, *Pollution control.

The principal causes of air and water pollution, the costs of pollution abatement, and the legislative and enforcement measures taken by various levels of government to control the environment are reviewed. Important technological developments and actions taken by industry to halt pollution are included. The increasing magnitude of the problem is caused by 2 main factors: urbanization and technical advance. Today's water pollution problems are much different than the typhoid fever problems a few decades ago; the problems today are concerned with synthetic chemical contaminants. The Federal Water Pollution Control Administration estimates that at least \$26 billion will be needed to bring lakes and streams up to water quality standards by 1973. Federal, state, and local air and water pollution programs are discussed. Federal legislation on air and water pollution is reviewed. A resume is included of the Manufacturing Chemists Association report on the activities of the chemical manufacturing industry to control pollution. A directory is given of companies offering equipment, products, services, or supplies for use in pollution control. (USBR)

W70-01100

RIPARIAN WATER RIGHTS V A PRIOR APPROPRIATION SYSTEM: A COMPARISON,
Charles M. Haar, and Barbara Gordon.
Boston U L Rev, Vol 38, No 2, p 207-255, Spring 1958. 49 p, 50 ref.

Descriptors: *Riparian rights, *Prior appropriation, *Water rights, *Massachusetts, Water utilization, Water law, Legislation, Riparian land, Priorities, Water users, Surface-groundwater relationships, Surface waters, Groundwater, Legal aspects, Reasonable use, Riparian waters, Prescriptive rights, Administrative agencies.

A riparian state like Massachusetts needs to evaluate its own riparian system before discarding or modifying it in favor of a revision of water rights under a prior appropriations system. A proposed Michigan statute adopting a prior appropriation system and the present Massachusetts riparian system based upon common law traditions, case law, and statutes provides a basis for an initial comparison of the two systems, including discussions of watercourses, surface water, riparian land, appurtenant water rights, abandonment of water rights and groundwater. The adoption of a prior appropriation system in Massachusetts would have the effect of changing the present law, rather than merely declaring the law with the probable result of changing various property rights and obligations. A change from the riparian rule of 'reasonable use' to a prior appropriation system would also prove to be

a costly solution without sufficient benefits over the present system. The seeming virtues of a fixed appropriation system should not be held as necessarily superior to a system of administrative and case determination of water rights. An analysis of water problems under the present system is preferred over the adoption of a different system. (McDonough-Florida)
W70-01139

RIPARIAN WATERS RIGHTS V A PRIOR APPROPRIATION SYSTEM: A COMPARISON,
Charles M. Haar, and Barbara Gordon.
Boston U L Rev, Vol 38, No 2, p 208-235, Spring 1958.

Descriptors: *Massachusetts, *Riparian rights, *Prior appropriation, *Water users, Water rights, Water law, Riparian waters, Reasonable use, Priorities, Water utilization, Legislation, Legal aspects, Riparian land, Prescriptive rights.

Massachusetts' riparian law is compared with a proposed Michigan prior appropriation statute to determine if the Commonwealth should adopt that system. The Michigan statute divides water rights into Class A riparian rights and Class B appropriative rights. Class B water users apply to a commission to obtain water priority rights. The Massachusetts riparian doctrine gives each riparian the right to reasonable use of all water available unless his right is enlarged or diminished by grant or prescription. This method allows a fundamental equality among claimants lacking in the prior appropriation system. Courts consider all circumstances to determine reasonable use as no lawful use is unreasonable per se. Courts must, however, await suits prior to determining water rights. Massachusetts Mill Acts provide for competing use of streams for power purposes without giving fixed priorities. This provides an amalgamation of statutory prior appropriation and common law reasonable use. The Michigan proposal would change Massachusetts law by limiting possible claimants to Class A owners without protecting non-riparian prescriptive users. (McDonough-Florida)
W70-01140

RIPARIAN WATER RIGHTS V A PRIOR APPROPRIATION SYSTEM: A COMPARISON,
Charles M. Haar, and Barbara Gordon.
Boston U L Rev, Vol 38, No 2, p 235-239, Spring 1958.

Descriptors: *Massachusetts, *Riparian rights, *Prior appropriation, *Water rights, Groundwater, Surface-groundwater relationships, Surface waters, Priorities, Water users, Reasonable use, Riparian waters, Prescriptive rights, Water law, Legal aspects, Legislation, Diversion.

The Michigan proposal defines 'watercourse' as a natural stream in a definite natural channel. The Massachusetts definition is similar but includes man-made channels within the 'natural' category. The adoption of the Michigan section would be a codification of case law rather than a modification but may in fact exclude non-natural watercourses. Michigan defines surface water as occurring naturally on the surface of the ground rather than watercourses, lakes, or ponds. Although the term is not explicitly defined by Massachusetts' decisions, the concept is identical. A recitation of illustrative instances is a better view. Michigan views riparian land as the smallest tract held under one title in the chain leading to the present owner. Massachusetts considers land abutting a watercourse as riparian and does not attempt to limit the term in area. The Michigan proposal would limit water use to an amount for reasonable beneficial use and requires application and approval prior to any lawful diversion. Massachusetts allows all riparians any reasonable use not injuring others and allows the taking of prescriptive rights to water use. The Michigan proposal would change present law. (McDonough-Florida)
W70-01141

RIPARIAN WATER RIGHTS V A PRIOR APPROPRIATION SYSTEM: A COMPARISON,
Charles M. Haar, and Barbara Gordon.
Boston U L Rev, Vol 38, No 2, p 239-255, Spring 1958.

Descriptors: *Massachusetts, *Riparian rights, *Prior appropriation, *Administrative agencies, Water rights, Water law, Judicial decisions, Prescriptive rights, Riparian land, Legal aspects, Water law, Legislation, Reasonable use, Riparian waters, Water users, Planning.

Many of the advantages in a prior appropriation system lie in the nature of administrative agency determinations as contrasted with judicial determinants under a riparian doctrine. Agencies presume expertise, but Massachusetts also utilizes expertise by appointing a 'master' in water law cases. Although the prior appropriation fixes a quantity of water to be used indefinitely, it lacks the flexibility of judicial determinations. It doesn't follow that the repudiation of the riparian system in favor of a prior appropriation system will solve Massachusetts' problems. Massachusetts needs to gather more data on all phases of water law and appoint commissions to develop a series of comprehensive plans on water needs upon which courts can base their decisions. (McDonough-Florida)
W70-01142

PEARL RIVER BASIN DEVELOPMENT DISTRICT ACT.

Miss Code Ann secs 5956-251 thru 5956-253, 5956-255 thru 5956-258, 5956-260, 5956-261, 5956-269 (Supp 1968).

Descriptors: *Mississippi, *River basins, *Administrative agencies, *Water resources development, Rivers, Taxes, Financing, Tax rates, Leadership, Legislation, State governments, Federal government, Overflow, Dams, Erosion control, Floodwater, Flood protection, Flooding, Flood control, Recreation facilities, Parks, Appropriation, Eminent domain, Forests, Soil conservation, Tributaries.

Identifiers: *River basin districts.

To conserve, store, and regulate the waters of the Pearl River and its tributaries and their overflow waters, this act authorizes the organization of the Pearl River Basin Development District. The Act provides for the selection and composition of a board of directors for such District and establishes procedures for the District's creation. Counties becoming members of the District are required to make annual payments thereto from funds raised by special tax levy. Numerous powers are given the District, including the power: (1) to impound and appropriate overflow and surface waters of the Pearl River and its tributaries; (2) to forest and reforest; (3) to prevent soil erosion; (4) to acquire lands by condemnation; (5) to require relocation of roads, railroads, power lines, and other named facilities; (6) to inundate public lands; (7) to establish and operate necessary facilities; and (8) to establish public parks and recreation facilities. The Act further gives the board of directors power to promulgate regulations for the District and set forth penalties for violations thereof. The District may also borrow money and issue bonds. (H R Marsse-Florida)
W70-01157

PEARL RIVER BASIN DEVELOPMENT DISTRICT ACT.

Miss Code Ann secs 5956-251 thru 5956-253, 5956-255, 5956-256 (Supp 1968).

Descriptors: *Mississippi, *River basins, *Administrative agencies, *Water resources development, Soil conservation, Rivers, Taxes, Tax rate, Financing, Leadership, Legislation, State governments, Overflow, Erosion control, Dams, Floodwater, Flood protection, Flooding, Flood control, Recreation facilities, Parks, Forests, Forestry, Tributaries, Water pollution control, Pollution abatement.

Identifiers: *River basin districts.

Field 06—WATER RESOURCES PLANNING

Group 6B—Evaluation Process

The Pearl River Basin Development District is created to conserve, store, and regulate the waters and overflow waters of the Pearl River and its tributaries for: (1) commercial, municipal, industrial, agricultural, and manufacturing purposes; (2) recreational uses; (3) flood control; (4) timber development and irrigation; (5) navigation; (6) soil conservation; and (7) pollution abatement. All powers of the District shall be exercised by a board of directors to be selected and composed as herein provided. Any county may, through its board of supervisors, become a member of the District. Counties becoming members of the District are required to make annual payment thereto from funds raised by special tax levy. (Marsee-Florida)
W70-01158

PEARL RIVER BASIN DEVELOPMENT ACT.

Miss Code Ann secs 5956-257, 5956-258, 5956-261, 5956-260, 5956-269 (Supp 1968).

Descriptors: *Mississippi, *River basins, *Administrative agencies, *Water resources development, Rivers, Legislation, State governments, Federal government, Overflow, Dams, Erosion control, Floodwater, Flood protection, Flood control, Recreation facilities, Parks, Appropriation, Eminent domain, Forests, Soil conservation, Tributaries, Grants, Financing, Surveys.
Identifiers: *River basin districts.

The Pearl River Basin Development District is empowered to: (1) develop, in conjunction with federal and state agencies, plans for the conservation, development, storage, and regulation of soil and waters within the Pearl River Basin; (2) develop waters for navigation and prevention of flood damage; (3) acquire property by purchase, lease, or gift; (4) obtain grants and loans from the United States; (5) contract; (6) make surveys relating to the construction of dams and reservoirs; (7) impound for beneficial use the overflow and surface water of the Pearl River and its tributaries; (8) forest and reforest, and prevent soil erosion and flooding within the District; (9) store and preserve waters for irrigation and prevention of water pollution; (10) acquire property interests by eminent domain; (11) require the relocation of roads and highways, railroad lines, telephone and telegraph lines, properties, electric power lines, gas pipelines, and mains and facilities; (12) inundate public lands; (13) issue bonds; (14) fix and collect charges for services, facilities, or commodities furnished by the District; (15) lease or sell property; and (16) establish public parks and recreation facilities. (Marsee-Florida)
W70-01159

FEDERAL WATER RESOURCES DEVELOPMENT.

Va Code Ann secs 62.1-148 thru 62.1-152 (1968).

Descriptors: *Virginia, *Local governments, *Water resources development, *Federal government, Flood control, River and Harbors Act, Rivers, Harbors, Easements, Right-of-way, Eminent domain, Condemnation, Dams, Roads, Spillways, Leases, Pipelines, Dikes, Drains, Dredging, Cutoffs, Federal project policy, Projects.

The governing body of any county, city, or town may assure the federal government of fulfillment of the required items of local cooperation that are conditions precedent to the accomplishment of river and harbor flood control projects of the United States. Such assurances, by resolutions or ordinances, may irrevocably bind such county, city, or town: (1) to provide lands, easements, or rights-of-way; (2) to alter existing structures on such areas; (3) to dredge areas not covered by the federal project when required; (4) to construct and maintain public wharves, roads, and marine railroads; (5) to remove sewer pipes and submarine cables; (6) to hold the United States harmless against claims for damages; and (7) to provide any other conditions of local cooperation required in the per-

tinent congressional document. To comply with such terms of local cooperation, the necessary lands may be acquired by lease, purchase, gift, or condemnation. This chapter shall be liberally construed. (Schram-Florida)
W70-01179

WATER POWER AND RESOURCES.

Va Code Ann secs 10-113 thru 10-113.2, 10-115 thru 10-117.1 1964.

Descriptors: Virginia, Water resources development, Administrative agencies, Hydroelectric power, Artesian wells, Conservation, Water resources, Resources, Control, Water supply, Surveys, Industrial water, Farms, Seasonal, Streams, Rivers, Water storage, Legislation, Resource development, Industries, Fluctuation, Administration.

In the Department of Conservation and Development there shall be a Division of Water Resources. The Commissioner of Water Resources shall exercise all powers conferred upon him by law, including those in relation to water power, resources, development, and control. The Director of Conservation and Development shall take evidence and report findings concerning conservation of the state's water supply. He shall gather and disseminate information relative to the water powers and industrial advantages in this state. To promote the systematic development of such industrial resources, a comprehensive water power survey shall be made showing the resources and commercial needs of hydroelectric power for community or farm purposes. Such survey shall include the extent of the water powers suitable for profitable use, both developed and undeveloped, the maximum and minimum power available according to seasonal flow of various streams, the possible uses of water storage and conservation, and the advantages of interconnecting hydroelectric systems. The owner of any artesian well shall secure the mouth of such well so as to prevent the waste of any water. Smith-Florida
W70-01192

THE LAND AND WATER USE SURVEY OF NORTH-CENTRAL KORDOFAN (1961-66),
London Univ. (England). School of Oriental and African Studies.
For primary bibliographic entry see Field 03B.
W70-01198

THE CHANGING ROLE OF WATER IN ARID LANDS,

Chicago Univ., Ill. Dept. of Geography.
Gilbert F. White.
Arizona Review, Vol 17, No 3, p 1-8, Mar 1967. 8 p.

Descriptors: *Arid lands, *Water resources development, *Water allocation (Policy), *Urbanization, *Consumptive use, Evapotranspiration control, Desalination, Economics, Irrigation, Industrial water, Social aspects, Water rates, Technology.

This paper is based on a lecture delivered by Dr. White at the University of Arizona in 1960. The author states that one-third of the earth's surface is arid. New pressures on arid lands set the scene for unprecedented social and technical changes. New technology is rapidly advancing the finding, lifting, storing, conveyance, and treatment of water. Urbanization is leading to industrial growth and demand for water. In many areas consumptive use has approached the potential supply. Still, large volumes are annually lost to evaporation and transpiration. In Asia and Africa much irrigated land is lost to water logging and salinization even as new lands are developed. Better use of present irrigation water is needed. A change in public attitude is required to set fair prices that will force rational reallocation of existing water supplies, develop methods for equitable transfer, and make more ra-

tional decisions on new investment in water development. New emphasis in technology may be needed: investment in research to reduce evapotranspiration losses may be a better alternate than new salt-water conversion works which have application only to limited areas. (Crouse-Arizona)
W70-01199

THE ECONOMICS OF ARIZONA'S WATER PROBLEM,

Arizona Univ., Tucson. Dept. of Agricultural Economics.
For primary bibliographic entry see Field 06D.
W70-01200

THE ASWAN HIGH DAM,

Texas Univ., Austin.

Robert K. Holz.

Professional Geographer, Vol 20, No 4, p 230-237, July 1968. 8 p, 2 tab, 3 fig, 7 ref.

Descriptors: *Arid lands, *Dam Construction, *Land reclamation, *Reservoir evaporation, *Population, Irrigated land, Reservoir leakage, Multi-purpose projects, Economic impact, Social impact, SCIENCE IMPACT, Benefits.

Identifiers: *Aswan Dam, *United Arab Republic, *Nile Valley.

Egypt has tied much of their hope for political, social, and economic development to construction of the High Aswan Dam. There is little doubt that it will be completed on schedule in 1970 or earlier. However, recent studies have revised downward the estimated area that may be brought under irrigation as a result of availability of only marginal land, and uncertainties as to evaporative and seepage losses. However, there should be at least a 25% increase in cultivated land (1.5 million acres) and a doubling of national output of electricity as well as flood and navigation benefits. Aggregate income will increase but because of a rapidly increasing rate of population growth, per capita effects may be negligible among the masses of fellahs. While a step in the right direction, the High Aswan Dam is not a panacea for Egypt's economic ills. (Crouse-Arizona)
W70-01201

OASES FOR THE FUTURE,

Rochester Inst. of Tech., N.Y.

Kenneth Hickman.

Ekistics, Vol 23, No 137, p 193-198, 1967. 6 p.

Descriptors: *Water resources development, *Water shortage, *Water supply, Desalination plants, *Reclaimed water, Water conveyance, Weather modification, Water waste treatment, Water reuse, Municipal water, Costs, Consumptive use.

Identifiers: *Oases.

This is a general review of the world's water 'problem' and possibilities for its solution. On the average the world's supply of fresh water is sufficient to meet world population needs for the foreseeable future. The regional situation is very different - one in which much of the world is now or will soon be short of fresh water because of pollution of existing supplies or poor distribution of precipitation resulting in aridity. Aside from the apparently limited possibilities of weather modification, water can be reclaimed on site or redistributed by conveyance or saline water can be converted. In most cases cost becomes lower as the size of the project becomes larger. Hence, emphasis is on large scale projects for integrated areas. Since most water needs remain local, a real need exists for development of small, packaged units to convert or reclaim water. (Crouse-Arizona)
W70-01203

WATER SUPPLIES IN SOUTH AUSTRALIA,

Hull Univ. (England). Dept. of Geography.

For primary bibliographic entry see Field 03B.
W70-01204

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

AQUEDUCT ROUTE OPTIMIZATION BY DYNAMIC PROGRAMMING,

Technion - Israel Inst. of Tech., Haifa; and Water Planning for Israel Ltd., Tel Aviv. Water Supply Section.

For primary bibliographic entry see Field 04A.
W70-00894

6D. Water Demand

DYNAMIC ASPECTS OF URBAN WATER DEMAND,

Colorado School of Mines, Golden.

Steve H. Hanke.

Proc, Fourth Amer Water Resources Conf, NY, p 642-650, Nov 1968. 9 p, 1 fig, 1 tab, 18 ref.

Descriptors: *Mathematical models, *Optimization, *Design, *Water demand, *Planning, Water supply, Annual, Average, Seasonal, Rates, Distribution systems, Treatment, Water distribution (Applied), Municipal water.

Identifiers: Dynamic Model.

The problem of how to best manage urban water resources was discussed. The purpose of the paper was to present economic principles and techniques that would aid water managers when planning for optimal use of urban water resources. Designs based on the water 'requirements approach' ignored factors that could cause the demand function to shift or could induce movements along the function. The problem of optimally designing in detail the basic source, transmission treatment and local distribution components of an urban water supply could be tackled better if the following characteristics were known and understood: (1) average annual rate of demand; (2) seasonal average rates of demand; (3) the range of variation in the rates of demand; and (4) the frequency with which peak demands occur. A dynamic mathematical model for optimally designing and investing in urban water resources was developed and recommended over static approach design models. (Thiurri-Cornell)
W70-00899

THE DILEMMA OF WATER RECREATION AND A SUGGESTED SOLUTION,

G. Graham Waite.

Wis L Rev, Vol 1958, No 4, p 542-609, July 1958. 58 p, 248 ref.

Descriptors: *Wisconsin, *Recreation facilities, *Lakes, *Competing uses, Water rights, Riparian rights, Land tenure, Reasonable use, Relative rights, Water utilization, Recreation demand, Water demand, Public health, Access routes, Land use, Non-consumptive use, Water allocation (Policy), Legal aspects, Judicial decisions, State governments, State jurisdiction, Federal jurisdiction, Navigable waters, Public rights.

Identifiers: *Lake management programs.

Pressures on state recreational facilities have created an urgent need for government action. Direct state management of navigable lakes is a possible solution to the problem of providing better facilities. Difficulties with the plan involve its apparent conflict with certain provisions of both the Northwest Ordinance of 1787 and the Wisconsin Constitution. A further problem is the extension of the trust theory, which provides that the state holds public rights in navigable waters in trust for the people of the state, to cover use of riparian lands owned by private persons for public access to navigable lakes and taxation of private riparian owners who use public waters exclusively. The author contends that the Northwest Ordinance is inapplicable today and that the government would not be violating the state constitution's general prohibition against state construction of internal

improvements by managing navigable lakes. The state has a affirmative duty as trustee of public waters to promote public rights, and according to the author this justifies interference with private riparian lands. (Kelly-Florida)
W70-00930

THE DILEMMA OF WATER RECREATION AND A SUGGESTED SOLUTION (PART I),

G. Graham Waite.

Wis L Rev, Vol 1958, No 4, p 542-567, July 1958.

Descriptors: *Wisconsin, *Lakes, *Recreation facilities, *Access routes, State jurisdiction, Federal jurisdiction, Navigable waters, Public health, Recreation, Water resources, Water allocation (Policy), Legal aspects, Land tenure, Compensation, Condemnation, Water management (Applied), Water conservation.

Increasing population, increasing amounts of leisure time available to the working public, and a growing reluctance on the part of owners of private lakes to open them to public use have combined to render the state's water recreational facilities inadequate to meet the needs of its citizens. Comprehensive lake management by the state is suggested as a method of solving this problem. Some question exists regarding the state's ability to require payment for use of public waters, or to tax riparian owners who use navigable waters while excluding the public because of a prohibition of interfering with navigable waters and of taxing for their use contained in the Northwest Ordinance of 1787. It is uncertain whether the ordinance survived Wisconsin's admission into the Union, since it applied to the federal territories. Wisconsin's treatment of the ordinance has been ambiguous, but an interpretation that the ordinance is no longer applicable could be drawn from case law. The author submits that water conservation and allocation of water use, in a comprehensive scheme of navigable waters management rendering recreational facilities available to a greater number of persons, may receive favorable consideration in the courts. (Kelly-Florida)
W70-00931

THE DILEMMA OF WATER RECREATION AND A SUGGESTED SOLUTION (PART II),

G. Graham Waite.

Wis L Rev, Vol 1958, No 4, p 567-609, July 1958.

Descriptors: *Wisconsin, *Lakes, *Riparian rights, *Recreation facilities, Relative rights, Compensation, Reasonable use, Recreation, State jurisdiction, State governments, Judicial decisions, Water allocation (Policy), Navigable waters, Federal jurisdiction, Public health, Legal aspects, Recreation demand, Public rights, Water conservation, Water management (Applied).

The feasibility of a plan of state management of navigable lakes for recreational purposes depends in part upon the state's power to interfere with a riparian owner's use of his property without paying compensation. The author urges the courts to uphold this power, pointing to the present uncertainty in Wisconsin case law concerning both the riparian owners' exclusive access rights to adjoining navigable waters and the need for compensation of riparian owners for the kind of interference with their lands that a lake management program would require. The state constitutional prohibition against internal improvements being carried out by the state may impede the development of lake-management projects sponsored by the state. An exception to this rule is that the state may provide internal improvements in performing one of its governmental functions. Preservation and promotion of public rights in public waters can be construed as a governmental function under the trust theory because the trust in which the state holds navigable waters for the people is an active one and also because providing recreational facilities promotes public health. The author further urges state university projects on publicly-owned riparian

land and comprehensive land use zoning to further the management plan. (Kelly-Florida)
W70-00932

GOVERNMENTAL RESTRICTION OF WATER USE,

Charles N. Huber.

Wis L Rev, Vol 1959, No 2, p 341-346, Mar 1959. 6 p, 34 ref.

Descriptors: *Wisconsin, *Riparian rights, *Public rights, *Water pollution, Judicial decisions, Legal aspects, Legislation, Water law, Regulation, Boating, Swimming, Lakes, Water supply, Easements, Reasonable use, Cities, Recreation, Public utilities, Local governments, Natural streams, Relative rights, Remedies, Water pollution control.

Identifiers: *Riparian owners.

The defendant city acquired from plaintiff riparian owner an easement to take water from Lake Lavina. The city then passed an ordinance prohibiting contamination of the lake by bathing, boating, and swimming. The plaintiff sought to have the ordinance declared invalid as a taking of property without compensation. The trial court found for the city. The Wisconsin Supreme Court in *Bino v City of Hurley*, 273 Wis 10, 76 NW2d 571 (1956), reversed on the grounds that riparian owners have a right to the reasonable use of the water of the lake. This right is a property right which carries with it the privilege to use the lake for bathing, swimming, and boating purposes, and, if a city is to deprive a person of such a right, that person must be compensated. The criticism is made that the court, influenced by the equities of the case, announced too sweepingly that the riparian right here involved was a property right. The author suggests that the decision will have little precedential value in a similar situation involving a state statute because of the greater police power possessed by the state and because of the fact that, in reality, public rights as well as riparian rights were involved in Hurley. The argument is made that in Hurley the plaintiff's use was not reasonable in the sense that it resulted in contamination of a public water supply. (Keith-Florida)
W70-00938

SEWAGE FLOW VARIATIONS IN INDIVIDUAL HOMES,

American Society of Civil Engineers, New York.

For primary bibliographic entry see Field 08B.

W70-01055

PEAK FLOWS OF SEWAGE FROM INDIVIDUAL HOUSES,

American Society of Civil Engineers, New York.

For primary bibliographic entry see Field 08B.

W70-01062

RHODE ISLAND WATER RESOURCES BOARD.

R I Gen Laws Ann secs 46-15-1 thru 46-15-10, 46-15-13, 46-15-18, 46-15-19 (Supp 1968).

Descriptors: *Rhode Island, *Administrative agencies, *Water resources development, *Water policy, Water resources, Legislation, Legal aspects, Droughts, Water supply, Water permits, Permits, Water requirements, Water shortage, Water utilization, Water works, Water yield improvement, Administration, Cities, State governments, Leadership, Local governments, Planning, Multiple-purpose projects, Taxes, Regulation, Coordination.

The greatly accelerated demands for more water and a continuing drought have created such serious problems of water resource development, utilization, and control that coordinated governmental and private action is necessary. For this purpose the Water Resources Board is created and its powers and duties set forth. The qualification

Field 06—WATER RESOURCES PLANNING

Group 6D—Water Demand

procedures for appointment and expenses of Board members are provided. The powers of municipal water agencies, special water districts, and private water companies are restricted. These entities must acquire the approval of the Board before performing specified acts related to water supply facilities. The procedure for the approval of project plans and maps is outlined. No governmental agency or district nor any private company may supply water to other states or water supply systems without Board approval. The Board is granted the power to: (1) enter upon lands and waters for purposes of survey; (2) examine the books, records, and accounts of municipal water departments, special water districts, and private water companies; and (3) require the above bodies to file reports with the Board. The Board's relation to governmental agencies is defined, and Board properties and facilities are exempted from taxation. (Marsee-Florida)
W70-01187

RHODE ISLAND WATER RESOURCES BOARD.

R I Gen Laws Ann secs 46-15-1 thru 46-15-5 (Supp 1968).

Descriptors: *Rhode Island, *Administrative agencies, *Water resources development, *Water policy, Water resources, Legislation, Legal aspects, Droughts, Water requirements, Water shortage, Water utilization, Water yield improvement, Administration, Cities, State governments, Leadership, Local governments, Planning, Institutions, Multiple-purpose projects.

In recent years the combination of new technology resulting in accelerated water demand, population growth, and a continuing drought has threatened the supply of water for domestic, industrial, and recreational use. State government, State and municipal departments, special districts, and private firms must coordinate their efforts toward the control, utilization, and development of the state's water resources. Toward this goal, the Water Resources Board is created. Each member of the Board must be qualified and appointed as provided herein. The members serve without compensation but are reimbursed for their expenses. The officers of the Board and the vote required for action are designated. (Marsee-Florida)
W70-01188

RHODE ISLAND WATER RESOURCES BOARD.

R I Gen Laws Ann secs 46-15-6 thru 46-15-10 (Supp 1968).

Descriptors: *Rhode Island, *Water resources development, *Water supply, *Water policy, Administrative agencies, Water resources, Legislation, Legal aspects, Loans, Water requirements, Water utilization, Water yield improvement, Administration, Cities, State governments, Local governments, Institutions, Multiple-purpose projects, Water permits, Permits, Reservoir operation, Pipelines, Eminent domain, Water works, Water zoning, Long-term planning, Regulation, Supervisory control (Power).

The Water Resources Board shall have the powers and duties to: (1) acquire the properties and facilities necessary for reservoirs and the treatment and distribution of water from the same; (2) exercise the power of eminent domain; (3) construct or purchase water supply facilities where no municipal water agency, special water district, or private water company is willing or able to do so; (4) formulate long-range programs for the development of water sources, transmission systems, and distribution systems; (5) divide the state into areas for providing water supply facilities; (6) regulate the construction and operation of water supply facilities within each area; and (7) make loans to public water supply agencies. No municipal water agency, special water district, or private water company may, without the Board's approval, acquire a water supply, take lands, extend supply or

distribution, extend transmission mains, extend water district boundaries, or supply water to municipalities already supplied by another agency. The procedure for obtaining such approval is outlined. No governmental agency or district nor any private company may supply water to other states or to other water supply systems without Board approval. (Marsee-Florida)
W70-01189

RHODE ISLAND WATER RESOURCES BOARD.

R I Gen Laws Ann secs 46-15-13, 46-15-18, 46-15-19 (Supp 1968).

Descriptors: *Rhode Island, *Administrative agencies, *Water resources development, *Taxes, Water resources, Water supply, Legislation, Legal aspects, Water works, Administration, Cities, State governments, Local governments, Assessments, Institutions, Leases, Surveys, Investigations, Supervisory control (Power).

The Rhode Island Water Resources Board has the authority to enter upon lands and waters for the purpose of making surveys, investigations, or examinations. Neither the Board nor any municipal water agency or department or special water district to whom the Water Resources Board has leased its properties or facilities shall be required to pay taxes on the same, or upon the income therefrom. The Board is empowered to make general rules and regulations for the enforcement of this Act. (Marsee-Florida)
W70-01190

THE ECONOMICS OF ARIZONA'S WATER PROBLEM,

Arizona Univ., Tucson. Dept. of Agricultural Economics.

Robert A. Young, and William E. Martin.
Arizona Review, Vol 17, No 3, p 9-18, 1967. 10 p, 6 tab, 14 ref.

Descriptors: *Arizona, *Agriculture, *Economics, *Cost-Benefit ratio, *Overdraft, Arid lands, Groundwater, Consumptive use, Irrigation, Water allocation (Policy), Water policy.

Identifiers: *Growth (Economic), *Central Arizona Project.

The authors hold that in Arizona, where per capita water consumption ranks among the highest in the nation, the price system should be proportionate to allocation of the water. At present the annual water deficit which is met by overdraft of groundwater, is 3.5 million acre feet, an amount equal to that consumed by low value extensive crops. These crops rank lowest among economic activities of the state in terms of dollars of personal income returned per acre foot of water used. Arizona's water problem is not one of physical shortage but of allocation of available water those economic sectors that will maintain a high rate of economic growth. Their estimates based on present plans for allocating Colorado River water diverted through the proposed Central Arizona Project cast doubt as to whether the Project can generate economic benefits in excess of costs of construction and operation. The fact that sufficient resources are available to finance the Project is no measure of its economic desirability. (Crouse-Arizona)
W70-01200

PATTERNS OF WATER USE IN THE ARIZONA ECONOMY,

Arizona Univ., Tucson. Dept. of Agricultural Economics.

William E. Martin, and Leonard G. Bower.
Arizona Review, Vol 16, No 12, Dec 1966, p 1-6, 6 p, 3 tab.

Descriptors: *Arizona, *Economics, *Overdraft, *Groundwater, *Agriculture, Decision making, Economic justification, Irrigation water, Consumptive use, Water demand, Industrial water, Mu-

nicipal water, Input-output analysis, Water allocation (Policy).

Identifiers: *Central Arizona Project.

Although water is scarce in Arizona its per capita use is over three times the national average. Past needs were met by diverting surface flow or tapping underground supplies. Solution of today's problem involves development of supplies outside the state or reallocation of existing supplies within the state, or both. In 1958 agricultural industries used over 90% of the water supplied for economic production. Relative use has probably remained similar. Food and feed grains consume about 50 acre-feet of water per \$1,000 output, compared with .032 acre-feet for the same value output in the mining industry. All uses total approximately seven million acre-feet per year compared with average annual income of 3.6 million acre-feet. Even with the addition of 1.2 million acre-feet from the Central Arizona Project there will be a large deficit and some reallocation will eventually be necessary even without growth. From the data presented it is evident that crucial reallocation decisions will likely fall upon crop agriculture if continued overdraft of groundwater is to be checked. (Crouse-Arizona)
W70-01202

WATER RESOURCES AND THE CHEMICAL INDUSTRY IN NEW JERSEY: AN ECONOMETRIC AND ENGINEERING ANALYSIS,

Rutgers - The State Univ., New Brunswick, N.J. Water Resources Research Inst.

M. L. Granstrom, M. Dutta, and J. DeRooy.
Available from the Clearinghouse as PB-187 727, \$3.00 in paper copy, \$0.65 in microfiche. Research Project Technical Completion Report, Water Resources Research Institute, Rutgers University - The State University of New Jersey, New Brunswick, New Jersey. Oct 1969. 303 p, 80 tab, 20 fig, 108 ref. OWRR Proj B-001-NJ and A-010-NJ.

Descriptors: *Water demand, *Water requirements, Water supply, Water utilization, Elasticity of demand.

Identifiers: *Chemical industry, Econometrics.

This report applies modern econometric and engineering techniques to the analysis of relationships of water to the chemical industry. Questionnaires were devised to obtain quality, quantity and costs of water taken in and discharged. Industrial demand for water resources is discussed in terms of production functions and technological change. Industrial demands for the future are projected for the chemical industry of New Jersey. (Whipple-Rutgers)
W70-01217

6E. Water Law and Institutions

STATE HIGHWAYS.

For primary bibliographic entry see Field 04A.
W70-00888

DAMS.

For primary bibliographic entry see Field 04A.
W70-00891

CONDEMNATION BY CITIES, COUNTIES, AND DISTRICTS FOR FLOOD CONTROL OR DRAINAGE.

Ky Rev Stat Ann secs 104.170-104.180 (1963).

Descriptors: *Kentucky, *Flood control, *Cities, *Condemnation, Legislation, Drainage, Levees, Soil conservation, Judicial decisions, Administrative agencies, Overflow, Local governments, Drainage districts, Flood protection, Channel improvement.

When any land, right of way, or easement over or through any property is needed by a city, county,

WATER RESOURCES PLANNING—Field 06

Water Law and Institutions—Group 6E

flood control, drainage, levee, reclamation or soil conservation district to perform work for flood control, flood protection or drainage purposes, the governing body may order the condemnation of the land or right of way. The judge of the circuit court shall grant and award immediate possession and full and complete use and control of said land or right of way to the city, county, flood control, drainage, levee, reclamation, or soil conservation district by an interlocutory judgment which shall be ordered immediately after the filing of the report by the commissioners appointed by the court. The commissioners may report at any time after summons has been fully issued or a warning order attorney appointed. The court may require a bond to be executed. The condemnation may not be abandoned after possession has been obtained unless none of the defendant parties will be materially prejudiced thereby. Cities of the fourth class may acquire land by purchase or condemnation for the purpose of straightening or widening any creek running through the corporate limits of the city to prevent or lessen the overflow thereof. (Heckerling-Florida)
W70-00895

LOWER MISSISSIPPI RIVER BASIN DEVELOPMENT DISTRICT.
For primary bibliographic entry see Field 04A.
W70-00912

FERRIES.
For primary bibliographic entry see Field 04A.
W70-00913

BASIC CONCEPTS IN GROUND WATER LAW,
For primary bibliographic entry see Field 04B.
W70-00914

THE CONSTITUTIONAL ASPECTS OF WATER POLLUTION AND THE NEED FOR GOVERNMENTAL COOPERATION,
For primary bibliographic entry see Field 05G.
W70-00915

PRIVATE WATER RIGHTS IN FRANCE AND IN THE EASTERN UNITED STATES,
For primary bibliographic entry see Field 06B.
W70-00916

PRIVATE WATER RIGHTS IN FRANCE AND IN THE EASTERN UNITED STATES,
For primary bibliographic entry see Field 06B.
W70-00917

PRIVATE WATER RIGHTS IN FRANCE AND IN THE EASTERN UNITED STATES,
For primary bibliographic entry see Field 06B.
W70-00918

PRIVATE WATER RIGHTS IN FRANCE AND IN THE EASTERN UNITED STATES,
For primary bibliographic entry see Field 06B.
W70-00919

NOTES ON WATER WORKS LAW SECOND INSTALLMENT - IRRIGATION AND RIPARIAN RIGHTS,
For primary bibliographic entry see Field 06B.
W70-00920

COMMENT: EXTENDING THE APPLICATION OF THE LAW OF ACCRECTIONS.
For primary bibliographic entry see Field 04A.
W70-00921

CONSTITUTIONAL LAW--COMMERCE CLAUSE--WATER RIGHTS IN THE FLOW OF

A NON-NAVIGABLE STREAM ARE PROPERTY RIGHTS,
For primary bibliographic entry see Field 04A.
W70-00922

STATUTORY STREAM POLLUTION CONTROL,
For primary bibliographic entry see Field 05G.
W70-00923

STATUTORY STREAM POLLUTION CONTROL,
For primary bibliographic entry see Field 05G.
W70-00924

STATUTORY STREAM POLLUTION CONTROL,
For primary bibliographic entry see Field 05G.
W70-00925

STATUTORY STREAM POLLUTION CONTROL,
For primary bibliographic entry see Field 05G.
W70-00926

REAL PROPERTY--RIPARIAN GRANTS-LEGISLATIVE LIMITATIONS ON EXTENT OF GRANT.
For primary bibliographic entry see Field 06B.
W70-00927

FEDERAL REGULATION OF WATERWAYS.
For primary bibliographic entry see Field 04A.
W70-00928

WATER AND WATER COURSES--SERVITUDES--ARTICLE 660, LOUISIANA CIVIL CODE OF 1870.
For primary bibliographic entry see Field 04A.
W70-00929

THE DILEMMA OF WATER RECREATION AND A SUGGESTED SOLUTION,
For primary bibliographic entry see Field 06D.
W70-00930

THE DILEMMA OF WATER RECREATION AND A SUGGESTED SOLUTION (PART I),
For primary bibliographic entry see Field 06D.
W70-00931

THE DILEMMA OF WATER RECREATION AND A SUGGESTED SOLUTION (PART II),
For primary bibliographic entry see Field 06D.
W70-00932

WATER POLLUTION CONTROL AND ABATEMENT (BOOK REVIEW); CONTROLLING POLLUTION: THE ECONOMICS OF A CLEANER AMERICA (BOOK REVIEW),
For primary bibliographic entry see Field 05G.
W70-00933

GOVERNMENTAL TECHNIQUES FOR THE CONSERVATION AND UTILIZATION OF WATER RESOURCES: AN ANALYSIS AND PROPOSAL.
For primary bibliographic entry see Field 06B.
W70-00934

GOVERNMENTAL TECHNIQUES FOR THE CONSERVATION AND UTILIZATION OF WATER RESOURCES: AN ANALYSIS AND PROPOSAL.
For primary bibliographic entry see Field 06B.
W70-00935

GOVERNMENTAL TECHNIQUES FOR THE CONSERVATION AND UTILIZATION OF WATER RESOURCES: AN ANALYSIS AND PROPOSAL.
For primary bibliographic entry see Field 06B.
W70-00936

NAVIGABLE WATERS--ARTIFICIAL LAKE CONNECTED TO RIVER,
For primary bibliographic entry see Field 04A.
W70-00937

GOVERNMENTAL RESTRICTION OF WATER USE,
For primary bibliographic entry see Field 06D.
W70-00938

CANALS AND WATERWAYS (UPPER MISSISSIPPI RIVERWAY COMPACT).
For primary bibliographic entry see Field 06B.
W70-00939

DRAINAGE (CHICAGO SANITARY DISTRICT).
For primary bibliographic entry see Field 04A.
W70-00940

DRAINAGE-SELECTION, QUALIFICATIONS, POWERS, AND DUTIES OF COMMISSIONERS AND OTHER OFFICERS.
For primary bibliographic entry see Field 04A.
W70-00941

WATER-DRAINAGE AND LEVEE DISTRICTS.
For primary bibliographic entry see Field 04A.
W70-00942

FISH AND GAME (LICENSES).
Ind Ann Stat secs 11-1425 thru 11-1433c (1956), as amended, (Supp 1968).

Descriptors: *Indiana, *Fish, *Permits, Legislation, Regulation, Ponds, Recreation, Water sports, Fish management, Fish conservation, Nets, Fishing gear, Fishing. Identifiers: Penalties.

Free permits to possess or purchase fish or game animals are issued to organizations organized for the purpose of wildlife protection. It is unlawful to use explosives in state waters without a permit. Applicable fines are included. Owners of private ponds may obtain free permits to use seines or traps on their premises. Indiana provides for reciprocal fishing permits with any state allowing Indiana residents to fish, without requiring a non-resident license, in waters forming a common boundary between Indiana and that state. (Moulder-Florida)
W70-00943

FISH (SEASONS, LIMITS, SPAWNING GROUNDS).

Ind Ann Stat secs 11-1601 thru 11-1604d (1956), as amended, (Supp 1968).

Descriptors: *Indiana, *Fish, *Spawning, *Fishing, Sport fishing, Legislation, Regulation, Administrations, Wildlife conservation, Fishing gear, Explosives, Electrical shocking gear, Fish toxins, Nets, Seines, Smelts, Fish conservation, Fish management. Identifiers: Penalties.

Fishing regulations covering closed seasons, lawful catches, minimum sizes, and bag limits are provided. The Director of the Department of Conservation sets aside lakes and streams as spawning grounds wherein it is unlawful to fish, operate any motorboat, or take any minnows. Unlawful fishing methods, with certain exceptions, are set forth and include the use of gig or spear, electrical device, dynamite, or fish toxins. Penalties for violation of

Field 06—WATER RESOURCES PLANNING

Group 6E—Water Law and Institutions

these provisions are provided. The taking of smelt is regulated. (Moulder-Florida)
W70-00944

TOMBIGBEE - TENNESSEE WATERWAY DEVELOPMENT COMPACT.
For primary bibliographic entry see Field 06B.
W70-00945

COMMERCIAL FISHING DEVICES - REGULATIONS.

Ind Ann Stat secs 11-1619 thru 11-1643 (1956).

Descriptors: *Indiana, *Fish, *Interstate compacts, *Fishing gear, Legislation, Regulation, Administration, Equipment, Nets, Commercial fishing, Trout, Trawling, Organic wastes, Pollution, Public health, Conservation, Dams, Water pollution, Lake Michigan, Fish conservation.
Identifiers: Penalties.

Interstate compacts may be entered into when necessary to protect fish in waters forming a common boundary line with some other state. Regulations pertaining to recording each day's catch, the locality fished, and the type of gear used in fishing Lake Michigan are included. It is unlawful for any person or firm to use nets, seines, and traps of specific types in Lake Michigan. Provisions for the use of commercial fishing nets and their impoundment for violations of the provisions are set forth. Season and size limit regulations for waters of the state as well as regulations concerning the unlawful use of certain fishing devices in Lake Michigan are included. The Department of Conservation may alter the above regulations. Certain regulations concerning lawful and unlawful fishing devices, undersize fish, and dams on the Wabash River boundary line are provided herein. All residue emanating from the catching, curing, or cleaning of fish in or near Lake Michigan shall be disposed of in a manner which will not pollute such waters. (Moulder-Florida)
W70-00946

SALVAGE.

Miss Ann Code secs 1007, 1008, 1010, 1011, 1019 (1956).

Descriptors: *Mississippi, *Watercourses, *Ownership of beds, *Streambeds, Legislation, Legal aspects, Gulf of Mexico, Boats, State jurisdiction, State governments, Relative rights, Remedies.
Identifiers: *Salvage, Salvage rights.

Any floatable thing of value that becomes derelict in any watercourse of the state or in the beds thereof and which has been relinquished, deserted, or abandoned shall become the property of the owner of the bed of the stream. Such owner may raise, float, or save said property. Any person claiming to be the owner of such property may institute an action in replevin for the recovery of such property. The defendant in such suit shall have a lien against the salvaged property for the expense of raising it. Any person who desires to claim compensation for salvage services rendered shall file a petition in the circuit court. If any person shall convert to his own use any floatable thing of value not belonging to him, he shall be guilty of a misdemeanor punishable by a fine of not less than double the value of the property converted or imprisonment not exceeding six months. (Schram-Florida)
W70-00947

HIGHWAYS, FERRIES, WATERWAYS.

Miss Code Ann secs 2203, 2205, 2206, 2210, 2211 (1956).

Descriptors: *Mississippi, *Bridges, *Bridge failure, *Navigable waters, Streams, Canals, Chan-

nels, Navigation, Transportation, Bays, Harbors, Water law, Legislation, Legal aspects, Lumbering. Identifiers: *Obstructions to navigation.

If any keeper or owner of a public ferry, toll-bridge, or causeway shall fail to give bond as required by law, suffer said structure to be out of good repair for more than five days, or cause any person to be unreasonably detained by carelessness, wilfulness, or negligence, such owner or keeper, upon conviction, shall be fined not more than fifty dollars. Any person who wilfully obstructs, breaks, or destroys any bridge, causeway, or ferry, which was established for the convenience of the public by the proper authority, shall be fined not more than one hundred dollars. Any person who obstructs in any way a stream or canal not less than one hundred and fifty feet wide without immediately removing the obstruction shall be guilty of a misdemeanor and shall be fined not more than fifty dollars or be imprisoned not more than one week. If any person shall obstruct any navigable bay, river, creek, or other navigable channel or shall discharge any ballast in a place other than that designated by the harbor commissioners, the offender shall be fined not more than one thousand dollars or imprisoned not longer than six months. (Schram-Florida)
W70-00948

FISH POISONING; POISONING WATER SUPPLY.

For primary bibliographic entry see Field 05G.
W70-00949

NAVIGABLE WATERS - PUBLIC HIGHWAYS.

Miss Code Ann secs 8413 thru 8418 (1956).

Descriptors: *Mississippi, *Navigable waters, *Navigation, Legislation, Navigable rivers, Lumbering, Bridges, Remedies, Obstruction to flow, State governments, Administration, Water law, Water policy, Water zoning, Water courses, Public rights.

All watercourses that have been or may be declared navigable, by act of the legislature or by the Board of Supervisors of the county in which the same may be, shall be public highways. All rivers, creeks, and bayous of twenty-five miles in length that have sufficient depth and width for thirty consecutive days in the year for floating a steamboat are declared to be navigable waters. Any person may enter and remove any and all obstructions across, in, or over any navigable stream. If any person obstructs a navigable stream by allowing logs to accumulate thereon, any other person may cause the jam to be broken. The cost for breaking the jam shall be borne by the owner of the accumulated logs. A lien on these logs shall exist for the payment of these costs. If any person floating timber or logs shall permit damage by such logs to be done to a bridge at public expense, he shall be liable therefor. Damages may be recovered by suit against him and the logs causing the damage may be seized and sold therefor. (Schram-Florida)
W70-00950

BRIDGES - BOUNDARY AND OTHER WATERS.

Miss Code Ann secs 8435 - 8447 (1956).

Descriptors: *Mississippi, *Bridge construction, *Boundaries (Property), *Bridges, Construction costs, Engineering structures, Administrative agencies, State governments, Federal government, Condemnation, Costs, Easements, Legal aspects, Eminent domain, Land tenure, Legislation, Damages, Financing, Local governments, Cities.

Any municipality or county or the State Highway Commission may construct and maintain toll or free bridges and approaches thereto. The bridges may extend over any bodies of water forming boundaries of the state. Funding of bridge construction may be accomplished by bonds. Municipalities may

operate under this title by ordinance or resolution without necessity of charter amendment. Where a contemplated bridge construction will be connected to the public highway system, the State Highway Commission may contribute to the cost of construction or maintenance. Public agencies may purchase or acquire by condemnation such lands or servitudes needed for bridge construction. Public agencies of adjoining states may operate under this act in construction and maintenance of bridges across Mississippi boundaries. Any municipality or other public body may secure federal funds or other assistance through government contracts. These contracts may be entered into by ordinance or resolution. (Kelly-Florida)
W70-00951

DRAINAGE DISTRICTS.

For primary bibliographic entry see Field 04A.
W70-00952

SWAMP LAND DISTRICTS.

For primary bibliographic entry see Field 04A.
W70-00953

FLOOD CONTROL - DRAINAGE DISTRICTS.

For primary bibliographic entry see Field 04A.
W70-00954

TOMBIGBEE RIVER VALLEY WATER MANAGEMENT DISTRICT.

For primary bibliographic entry see Field 04A.
W70-00955

TOMBIGBEE RIVER VALLEY WATER MANAGEMENT DISTRICT.

For primary bibliographic entry see Field 04A.
W70-00956

TOMBIGBEE RIVER VALLEY WATER MANAGEMENT DISTRICT.

For primary bibliographic entry see Field 04A.
W70-00957

PAT HARRISON WATERWAY DISTRICT.

For primary bibliographic entry see Field 05G.
W70-00958

PAT HARRISON WATERWAY DISTRICT.

For primary bibliographic entry see Field 05G.
W70-00959

PAT HARRISON WATERWAY DISTRICT.

For primary bibliographic entry see Field 05G.
W70-00960

BIG BLACK RIVER BASIN DISTRICT.

For primary bibliographic entry see Field 04A.
W70-00961

BIG BLACK RIVER BASIN DISTRICT.

For primary bibliographic entry see Field 04A.
W70-00962

BIG BLACK RIVER BASIN DISTRICT.

For primary bibliographic entry see Field 04A.
W70-00963

LOWER YAZOO RIVER BASIN DISTRICT.

For primary bibliographic entry see Field 04A.
W70-00964

LOWER YAZOO RIVER BASIN DISTRICT.

For primary bibliographic entry see Field 04A.
W70-00965

LOWER YAZOO RIVER BASIN DISTRICT.
For primary bibliographic entry see Field 04A.
W70-00966

SEA FOODS.

Miss Code Ann secs 6047-01 thru 6047-04, 6047-06, 6047-10 thru 6047-13, 6047-17, 6047-18, and 6051.5 (Supp 1968).

Descriptors: *Mississippi, *Fish conservation, *Marine fish, *Gulf of Mexico, Saline water fish, Commercial fishing, Commercial shellfish, Legislation, Saline water, Freshwater interfaces, Administrative agencies, Decision making, Leases, Rent, Permits, Oysters, Clams, Shrimp, Shellfish, Taxes, Tax rate, Canneries.

The public policy of Mississippi as to sea food laws is expressed. All of the wild aquatic life found in the waters of the State, until legally taken, is the property of the State. The Marine Conservation Commission is established to manage, control, supervise, and direct any matters pertaining to salt-water aquatic life. The organization of the commission, its members, and their compensation are outlined. The jurisdiction, authority, and duties of the commission are expressly provided. Generally, this empowers them to regulate all types of sea food except menhaden, trash fish, tuna, and red snapper. The rights of riparian owners on the Gulf Coast are defined. The commission is granted authority to lease the bottoms within its jurisdiction upon certain terms and conditions. The justices of the peace of the various counties are given jurisdiction over any prosecution or suit brought under this act. General penalties for violation of the provisions of this act are detailed. The commission is authorized and directed to assess and collect various licenses and taxes. The commission is also authorized to enter into an agreement for jurisdictional purposes as to the dividing line between salt and fresh waters. (Schram-Florida)
W70-00967

SEA FOODS.

Miss Code Ann secs 6047-01 thru 6047-04, 6047-06 (Supp 1968).

Descriptors: *Mississippi, *Fish, *Oysters, *Clams, Marine fish, Shellfish, Shrimp, Legislation, Fish conservation, Wildlife conservation, Saline water fish, Aquatic life, Reefs, Oceans, Gulf of Mexico, Marine fisheries, Commercial shellfish, Commercial fishing, Administrative agencies, Decision making.

Identifiers: *Sea foods, Propagation of marine life, Tongue reefs.

The public policy of the State is to recognize the need for a concerted effort to work toward the protection, propagation, and conservation of its sea food and aquatic life. All wild aquatic life existing in the waters of the State, including shell fish, are the property of the State until legally divested in the manner described herein. The Marine Conservation Commission is created and has the full power to manage, control, supervise, and direct any matters pertaining to saltwater aquatic life. The Commission shall be made up of ten members appointed by the governor with the qualifications herein. The Commission has authority over the taking, catching, and processing of shrimp, oysters, and crabs, but not over trash fish, menhaden, tuna, and red snapper. The Commission shall: (1) set standards of measure; (2) regulate fishing seasons; (3) set size, catching, and culling regulations; (4) set forth enforcement procedures and penalties for violation; (5) enter into advantageous interstate and intrastate agreements; (6) enact all ordinances necessary for the protection, conservation, or propagation of shrimp, oysters, and crabs; and (7) aid in the construction of canals to bring water to existing oyster reefs or beds. (Schram-Florida)
W70-00968

SEA FOODS.

Miss Code Ann secs 6047-10 thru 6047-13, 6047-17, 6047-18, 6051.5 (Supp 1968).

Descriptors: *Mississippi, *Riparian rights, *Oysters, *Saline water fish, Taxes, Tax rate, Assessments, Commercial fishing, Shellfish, Saline water, Freshwater interfaces, Gulf of Mexico, Leases, Rent, Permits, Shrimp, Canneries, Legislation, Fish conservation, Commercial shellfish.

The sole right of planting and gathering oysters in front of land bordering the Gulf of Mexico or Mississippi Sound belongs to the riparian owner and extends not more than 750 yards from the shore. The commission is granted authority to lease the bottoms within its jurisdiction upon certain conditions. These include: (1) lessees shall be residents of Mississippi; (2) leases must be for from five to one hundred acres; (3) applications for leases shall be considered in the order which they are filed; (4) rental shall be from one to five dollars per acre; and (5) all leases shall be subject to the paramount right of the state. The justices of the peace of the various counties shall have original jurisdiction over all prosecutions and suits brought under this act. A series of penalties for violations of this act are provided. The commission is authorized and directed to assess and collect taxes and licenses from (1) vessels catching, carrying, or transporting fish or oysters; (2) factories canning fish or oysters; (3) inspection fees; and (4) buyers or handlers of sea food. A provision for an agreement for jurisdictional purposes as to the dividing line between salt and fresh waters is provided. (Schram-Florida)
W70-00969

SEA FOODS: OYSTERS.

Miss Code Ann secs 6072, 6075-12, 6077, 6085-01, 6085-11 (Supp 1968).

Descriptors: *Mississippi, *Oysters, *Commercial shellfish, *Regulation, Fish harvest, Dredging, Inspection, Shellfish, Legislation, Administrative agencies, Local governments, Fish stocking, Fishing, Gulf of Mexico.

By order of the Seafood Commission, the Chief Inspector shall cultivate and improve the oyster beds under the control of the state of Mississippi. He may relocate oysters, spend funds for propagation, and advise the Commission of suitable sites for new beds. The Commission may prohibit taking oysters from areas where the water is impure or liable to be harmful to oysters. In certain areas dredging for oysters is prohibited, and no one may take oysters by any means after dark. Any municipality bounding on the Gulf of Mexico, which has an oyster bed within its corporate limits, may aid in enforcing the oyster laws of this state. (Darragh-Florida)
W70-00970

WESTPHAL V SCHMALZ (UNAUTHORIZED USE OF DRAINAGE SYSTEM).

For primary bibliographic entry see Field 04A.
W70-00971

BRYANT V PEPPE (ESTOPPEL TO ASSERT TITLE WHEN LAND CHANGED BY AVULSION).
226 So2d 357-358 (2d DCA Fla 1969).

Descriptors: *Florida, *Avulsion, Judicial decisions, Boundaries (Property), Shores, Assessments, Taxes, Accretion (Legal aspects).

Appellee's land was formerly separated from the Gulf of Mexico by land on the west which was obliterated by avulsion. The owners were denied a decree quieting title to the land now fronting on the Gulf because title was held to be in the state. The court has declared that avulsion precludes attainment of title by the private owners of adjoining property by accretion, but in this case the state was estopped from claiming title. The predecessor in

title had successfully defended his possessory right to the Gulf frontage in an action upheld by the Supreme Court. The tax assessor assessed the property as fronting on the Gulf for many years, and the state did not offer to do equity for the overcharge if the state was found to be the owner. The state's treatment of public property as property of private citizens may result in the loss of it. (Doublerley-Florida)
W70-00972

CONDEMNATION BY CITIES AND COUNTIES TO PROVIDE WATERSHEDS OR BEDS FOR WATER PIPES.

For primary bibliographic entry see Field 04A.
W70-00973

INSPECTION DISTRICTS; POLICE FLEET.

Va Code Ann secs 28.1-37 thru 28.1-46 (1969).

Descriptors: *Virginia, *Fishing, *Administrative agencies, *Commercial fishing, Commercial shellfish, Regulation, Administration, State jurisdiction, Legal aspects, Legislation, Permits, Boats, Inspection, Control, Surveys, Taxes.

The Commission of Marine Resources shall create inspection districts within its jurisdiction. The number of districts should be the smallest possible commensurate with the efficient enforcement of fish and shellfish laws. The Commission shall appoint chief inspectors and inspectors for each district. The Commission shall also designate officials in each district to collect fees for services and issuance of licenses. Inspectors are responsible for collection reports. The police fleet consists of the boats now operated by the Commission and may be enlarged in accordance with special law or general powers conferred by law. (Kelly-Florida)
W70-00974

FISH AND FISHING GENERALLY: FISH FOR MANUFACTURE INTO FISH MEAL, OIL.

Va Code Ann secs 28.1-58 thru 28.1-66 (1969).

Descriptors: *Virginia, *Commercial fishing, *Permits, Administrative agencies, Administration, Taxes, Commercial fish, Regulation, Reasonable use, Fish management, Fish conservation, Inspections, State jurisdiction, State governments, Tidal waters, Legislation, Legal aspects, Fish.

Identifiers: Penalties (Criminal), Purse nets, Fish meal, Fish oil.

Fish meal may not be taken for use in manufacture of fish meal or oil. One percent of a catch used for this purpose may consist of food fish, but only if all living food fish found in the net are immediately released. Violation of this provision is a misdemeanor. Those persons or corporations desiring to fish with purse nets for fish to be used in manufacture of fish meal, scraps, or oil must procure a license. The amount of the license tax depends upon the type and size of the operation. Except for taking menhaden fish, no non-resident will be licensed to catch fish for meal or oil manufacture in the waters of the state. The Commissioner of Marine Resources shall make final approval of license applications, subject to judicial appeal to the appropriate circuit court. Violation of this title will result in prosecution for a misdemeanor and forfeiture of any vessel and/or tackle used in the violation. Non-residents may be stockholders or employees of domestic corporations engaged in the fishing herein described. (Kelly-Florida)
W70-00975

FISH AND FISHING GENERALLY: TROLLS, TRAWL NETS, AND DRAG NETS.

Va Code Ann secs 28.1-67 thru 28.1-72.1 (1969).

Descriptors: *Virginia, *Commercial fishing, *Commercial fish, *Nets, Regulation, Trawling,

Field 06—WATER RESOURCES PLANNING

Group 6E—Water Law and Institutions

Productivity, Tidewaters, State jurisdiction, State governments, Fishing, Legislation, Legal aspects, Permits, Ships, Boats, Administration, Administrative agencies.

Identifiers: Trawl nets, Drag nets.

Use of a troll or trawl net, drag net or similar device drawn through the water by a vessel for the purpose of taking fish is prohibited. Purchase or sale of fish taken in this manner is also prohibited. The Commissioner of Fisheries may issue licenses for trawl fishing in specific areas during certain months. Otherwise, the finding of any vessel equipped for trawling or trolling is *prima facie* evidence of a violation of the statute. Any vessels used in the violation of the statute, together with tackle and cargo shall be forfeited to the state. Nothing in the statute prohibits the lawful transportation of fish caught outside the state jurisdiction into Virginia ports to be marketed. (Kelly-Florida)
W70-00976

FISH AND FISHING GENERALLY: MARKING OF BOATS, NETS, AND OTHER DEVICES.

Va Code Ann secs 28.1-73 thru 28.1-81 (1969).

Descriptors: *Virginia, *Commercial fishing, *Permits, *Administrative agencies, Commercial fish, Boats, Ships, Fish management, Fish conservation, Fish, Tidal waters, Nets, Inspections, Control, Regulation, State jurisdiction, State governments, Taxes.

The Commissioner of Marine Resources is obligated to provide license tags where required by statute or regulation. The inspectors furnish these tags to licensees upon payment of license taxes, and the tags must be prominently displayed. Tags for certain fishing devices are required. Any person employing a fishing device which requires the use of poles or stakes must remove all abandoned stakes, save one which can be left as an identification marker. The Commission may revoke the fishing licenses of those who fail to comply. Fishing in certain waters is prohibited. (Kelly-Florida)
W70-00977

TAKING OYSTERS GENERALLY.

Va Code Ann 28.1-82 thru 28.1-85 (1969).

Descriptors: *Virginia, *Oysters, *Commercial shellfish, *Shellfish, Reasonable use, State jurisdiction, Tidal waters, Fish conservation, Permits, Legislation, Legal aspects, Clams, Commercial fish, Commercial fishing, Regulation, Administrative agencies, State governments, Administration, Fishing, Control.

Identifiers: Oyster seasons, Oyster tongs, Natural oyster beds, Oyster seed beds.

Seasons are established for the taking of oysters from natural or public oyster beds, rocks, or shoals in the waters of the state. The length of the season varies with the location and with the fishing method used. The finding of any person possessing patent tongs or shaft tongs upon the public or natural oyster beds or shoals, at times other than those specified, is *prima facie* evidence of violation of this statute. No one may use patent tongs for catching oysters from natural beds in certain specified areas. The Commission may close or open any area, or restrict the manner of taking oysters in public or natural rocks, grounds or shoals, in order to protect and promote the growth of oysters. The Commission may establish seed beds and plant shells or take any other restorative measures it deems necessary. Closing of areas may be for any period, provided that notice is given. Reopening of oyster grounds need not be accompanied by notice. (Kelly-Florida)
W70-00978

OYSTER RECORDS AND TAXES.

Va Code Ann secs 28.1-87 thru 28.1-95 (1969).

Descriptors: *Virginia, *Oysters, *Taxes, *Commercial shellfish, Shellfish, State jurisdiction, Fish conservation, Permits, Legislation, Legal aspects, Commercial fishing, Regulation, Administrative agencies, Administration, Assessments, Costs, Tax rate, Tariff, Government finance, Financing, Inspection.

Identifiers: *Oyster replenishment, Oyster dealers, Oyster buyers, Oyster planting, Seed oysters.

Designated commercial oyster dealers are required to keep daily records of oysters packed or marketed by them. They must pay a specified tax on each bushel of oysters taken; the tax is to be collected by the district inspector or a police boat captain. The Commissioner or any inspector may examine any oysters taken or purchased as to quality or quantity. Persons purchasing oysters from those catching or taking oysters from public rocks, beds, or shoals must have an oyster buyer's license issued by the Commission of Marine Resources. Oyster buyers must also submit records of purchases to the Commission. All oyster replenishment taxes, collected on each purchase of oysters, are deposited in the Public Oyster Rocks Replenishment Fund, to be used for replenishment, planting, and replanting the public oyster rocks, beds, and shoals within the state jurisdiction with seed oysters, oyster shells, or other material to catch, support, and grow oysters. The Commissioner may contract with private persons or firms in carrying out the replenishment. (Kelly-Florida)
W70-00979

CARRYING OYSTERS FROM STATE OR CERTAIN GROUNDS.

Va Code Ann secs 28.1-96 thru 28.1-99 (1969).

Descriptors: *Virginia, *Oysters, *Permits, *Commercial shellfish, State jurisdiction, Fish conservation, Legislation, Legal aspects, Regulation, Reasonable use, Administration, Administrative agencies, Commercial fishing, Shellfish, Conservation, Fish management, Taxes.

Identifiers: Oyster seed areas.

Permits issued by the Commission of Marine Resources must be obtained before anyone may transport oysters out of the state. A tax on each bushel must be paid before a permit will be issued. The Commission is obligated to issue these permits unless, after examination of the seed areas, it is ascertained that removal would either deplete or injure the seed areas or render the remaining supply insufficient to meet residents' demands. State residents must obtain a permit before removing oysters from certain areas as well as before planting them within the state. (Kelly-Florida)
W70-00980

LICENSING OF STATIONARY AND FLOATING DUCK BLINDS.

Va Code Ann secs 29-83 thru 29-87, 29-90 (1969).

Descriptors: *Virginia, *Permits, *Riparian rights, *Administrative agencies, Hunting, Water-fowl, Migratory birds, Shores, Conservation, Wildlife conservation, Recreation, Legal aspects, Water utilization, Regulation, Control, Public rights.

Identifiers: Duck blinds, Trespass, Penalties (Criminal), Public waters.

Floating duck blinds must be licensed and may be anchored no closer than 500 yards to a stationary blind or other licensed floating blind. Fees for licenses for blinds are based on the type of blind, and licenses are issued between July 1 and October 31 of each year. Riparians have the exclusive privilege of licensing and erecting blinds on their shore and in the public waters in front of such shore, if licenses are obtained between July 1 and August 31. If such blinds are erected and tagged, no other stationary or floating blind may be located within 500 yards without the consent of the riparian or his lessee or permittee. The riparian's failure to exercise this privilege within the stated period al-

lows other persons to erect and license blinds in the offshore waters. Hunting from a boat, float, or raft other than a licensed blind within 500 yards of a licensed blind constitutes a trespass to the licensed blind. Violation of licensing and hunting provisions are a misdemeanor. (McDonough-Florida)
W70-00981

FISHING PERMITS; NATIONAL FORESTS.

Va Code Ann secs 29-108, 29-110, 29-114.1, 29-117 thru 29-120 (1969).

Descriptors: *Virginia, *Permits, *Fish management, *Fish conservation, Legislation, Legal aspects, Regulation, Fish, Rainbow trout, Brook trout, Fish reproduction, National forests, Natural resources, Administrative agencies, Federal government, Nets, Fyke nets, Gill nets, Financing, Sport fish, Wildlife management, Wildlife conservation, Fish farming, Fish hatcheries, Reproduction.

Identifiers: Licenses, Fish propagation.

The fee for a permit to breed and artificially raise rainbow trout and brook trout for sale from a privately owned hatchery is five dollars. The fees for permits to net certain species of fish by specified methods are established. The Commission is authorized to issue permits to private fish pond owners to sell game fish therefrom for propagation only. No person may fish in the national forests within the state without first obtaining, in addition to the regular resident or non resident license, a special permit at the cost of one dollar. Revenue from the sale of special permits will be used by the Commission for wildlife management purposes in the national forests within the state, or in the discretion of the Commission such revenue may be paid into the United States treasury for use of the United States Forest Service for wildlife management purposes in the national forests within the state. The Commission will enter into a cooperative agreement with the United States Forest Service to define ways to improve the wildlife resources of the national forests within the state and to program the expenditure of funds derived from special permit sales. (Keith-Florida)
W70-00982

THE TAKING OF MINERALS FROM BEDS AND NAVIGATION.

Va Code Ann secs 62.1-4 thru 62.1-9 (1968).

Descriptors: *Virginia, *Minerology, *Navigation, *Obstruction to flow, Legislation, Legal aspects, Administrative agencies, Regulation, Easements, Leases, Beds, Royalties, Fishing, Oysters, Shellfish, Dredging, Drilling, Wildlife conservation, Watercourses (Legal), Dams, Barriers, Mining, Dam construction, Relative rights, Ownership of beds.

Identifiers: *Marine resources, *Shells.

The Marine Resources Commission may grant easements in and leases to the beds of state waters. The terms of such easements and leases will specify the rent royalties and other proper terms. Such easements and leases may authorize the grantees and lessees to take oil, gas, and such other minerals as are therein specified, provided no such taking will interfere with the public rights of fishing, fowling, and oystering. The Commission of Game and Inland Fisheries is empowered to regulate drilling, dredging, or other operations designed to obtain shells or minerals in specified beds in order to prevent harm to wildlife. The circuit court of any county may contract to have obstructions removed from any watercourse within its jurisdiction. Any previous act granting the power to abate or remove dams or other works or to improve navigation is declared valid. The water use rights of the state or any company incorporated for navigation improvement will not be affected by any court order granting any person permission to obstruct any watercourse. Courts will not in the future issue any order which will result in an obstruction to navigation. (Keith-Florida)

Water Law and Institutions—Group 6E

W70-00983

STATE POLICY AS TO WATERS.

Va Code Ann secs 62.1-11 thru 62.1-13 (1968).

Descriptors: *Virginia, *Water resources, *Water conservation, *Public benefits, Legislation, Legal aspects, Regulation, Natural resources, Streams, Lakes, State jurisdiction, Water resources development, Watercourses (Legal), Contracts, Cities, Reasonable use, Public rights, Local governments, Water utilization, Usufructuary right.
Identifiers: *Policy.

The waters of the state are a natural resource which should be regulated by the state. The regulation, control, development, and use of waters for all purposes beneficial to the public are within the jurisdiction of the state which may establish measures to effectuate the proper utilization and protection of such waters. The needs of the people may require state water resources to be put to public uses. The waste or unreasonable use of water should be prevented, and the conservation of water is to be exercised with a view to the public welfare. The public welfare requires the proper development, wise use, conservation, and protection of water resources. The right to the use of water or to the flow of water in or from any natural stream, lake, or other watercourse is limited to such water as may be required for the public use. Nothing in this act will operate to affect any valid use of the waters of the state, nor will it be construed as applying to the determination of rights in any proceeding. The purpose of this act is to recognize the public use to which water is devoted, and the act will not divest any governmental unit of any rights or responsibilities. (Keith-Florida)
W70-00984

TAKING OF SEAWEED BY INHABITANTS OF BARRINGTON.

RI Gen Laws Ann secs 46-11-1 thru 46-11-3 (1956).

Descriptors: *Rhode Island, *Aquatic weeds, *Beaches, *Riparian plants, Consumptive use, Weeds, Seashores, Shores, Oceans, Relative rights, Vegetation, Crop production, Plants.
Identifiers: *Seaweed, Penalties (Criminal).

The inhabitants of the town of Barrington may, between sunrise and sunset, take seaweed from the public beach at Barrington. Each person shall be limited to two cart or wagon loads in one day. However, no person shall take more than one load until all others taking seaweed shall have obtained one load each. This privilege is restricted to Barrington inhabitants. Persons violating this act shall forfeit ten dollars for each load of seaweed carried off. (Marsee-Florida)
W70-00985

FISHING IN INTERSTATE NONTIDAL WATERS.

Va Code Ann secs 29-153.1, 29-153.2 (1969).

Descriptors: *Virginia, *Sport fishing, *Interstate compacts, *Permits, Legislation, Legal aspects, Fish, Fishing, Regulation, Administrative agencies, Wildlife management, Fish conservation, Water law, Interstate, Control, Water utilization.
Identifiers: *Nontidal waters, *Interstate waters, *Reciprocal agreements, Penalties (Criminal).

It is lawful for citizens of Virginia and citizens of adjoining states which have nontidal water partly in such adjoining state and partly in Virginia to fish in such interstate nontidal waters; each citizen must comply with his own state's laws for taking fish in such waters. The Commission of Game and Inland Fisheries is empowered to enter into a reciprocal agreement with any state sharing interstate nontidal waters with Virginia relating to the following:

(1) recognition of a resident sport fishing license acquired in an adjoining state when the licensee is fishing in such waters; and (2) strict observance of state creel limits, open seasons, and all other laws and regulations of the adjoining state. The failure of any person to comply with the rules established under such agreement will subject such person to criminal penalties. (Keith-Florida)
W70-01020

CLUBS, PRESERVES, AND NATIONAL FORESTS; COMPLIMENTARY LICENSES.

Va Code Ann secs 29-78 thru 29-80 (1969).

Descriptors: *Virginia, *Wildlife management, *Permits, *Wildlife conservation, Hunting, Fishing, Trapping, Administrative agencies, Conservation, Fish conservation, Forests, National forests, Public lands, Recreation.

All persons including those on the lands or waters of any public or private club must obtain a license before hunting, trapping, or fishing this state. A regular license, as well as a special permit, are required before any person may hunt, fish, or trap on any lands in the national forests in this state. The Commission of Game and Inland Fisheries may issue a limited number of complimentary hunting and fishing licenses to United States conservation officials. (McDonough-Florida)
W70-01021

STATEMENTS OF POLICY ON PUBLIC WATER SUPPLY MATTERS--AMERICAN WATER WORKS ASS'N PRINCIPLES OF NATIONAL WATER POLICY.For primary bibliographic entry see Field 05G.
W70-01130**BASIC WATER USE DOCTRINES AND STATE WATER CONTROL AGENCIES.**For primary bibliographic entry see Field 04A.
W70-01131**HAS RECENT LEGISLATION LIMITED PRIVATE RIPARIAN RIGHTS IN IOWA,**For primary bibliographic entry see Field 03D.
W70-01133**APPROPRIATION WATER LAW ELEMENTS IN RIPARIAN DOCTRINE STATES,**J. H. Beuscher.
Buffalo L Rev, Vol 10, No 2, p 448-458, Winter 1961. 11 p, 48 ref.

Descriptors: *Appropriation, *Water rights, *Riparian rights, *Water policy, Prior appropriation, Preferences (Water rights), Priorities, Natural flow doctrine, Competing uses, Regulation, Relative rights, Water allocation (Policy), Water utilization, Consumptive use, Waste dilution, Water demand, Public utilities, Water distribution (Applied), Water management (Applied), Domestic water, Reasonable use, Artificial use, Industrial water, Irrigation water, Mill dams, Riparian land, Riparian waters, Usufructuary right, Waste disposal, Zoning, Local governments.

It is an overgeneralization to say that humid states apply the riparian doctrine. Legislation, administration and adjudication in many instances deal more with appropriation principles rather than with riparianism. This is seen in three areas: the precedence given to the reasonable use doctrine over the natural flow precept in many decisions; the preferred protection given to a prior user as against a subsequent water claimant; and the willingness of courts to allow water to be taken for non-riparian lands. Courts have qualified correlative co-sharing by granting prescriptive rights to an open, notorious, adverse user. The right to domestic use has been extended to include water taken by municipal utilities, a right that is often

held to be superior to that of co-riparians. The riparian who is first to construct a mill dam has been granted appropriative status, often to the complete destruction of natural flow. Downstream riparians are treated as inferior to upstream riparian polluters, and many states give preferences to industrial users. Local governments can restrict the use of water by riparians by zoning the riparian land, thus disrupting co-sharing equality among riparians. A description of riparian water laws is a difficult task. (Doublerley-Florida)
W70-01134

CIVIL LAW PROPERTY--ENCROACHMENTS ON RIVER BANKS BY RIPARIAN OWNERS,
For primary bibliographic entry see Field 04C.
W70-01135**THE FEDERAL GOVERNMENT AND AIR AND WATER POLLUTION,**
For primary bibliographic entry see Field 05G.
W70-01136**ACQUISITION OF THE RIGHT TO USE WATER,**
Ewell P. Walther, Jr.
Tul L Rev, Vol 29, No 3, p 554-565, Apr 1955. 12 p, 123 ref.

Descriptors: *Water rights, *Water users, *Riparian rights, *Prior appropriation, Natural flow doctrine, Judicial decisions, Reasonable use, Legislation, Louisiana, Legal aspects, Water law, Water pollution, Subsurface waters, Relative rights, Water utilization, Usufructuary right.
Identifiers: Common law, Acquisition.

Water rights may be acquired in several ways. Generally, states east of the Mississippi employ the common law riparian rights doctrine, and western states adhere to the doctrine of prior appropriation either in conjunction with or exclusive of the doctrine of riparian rights. Water rights may also be acquired by contract and by prescription. Under the common law of riparian rights two theories have developed - the natural flow theory and the reasonable use doctrine. Both theories are defined herein. Under the prior appropriation doctrine, which the author favors, the first appropriator in time gains a superior right. All public waters are subject to appropriation. Many variations have been developed by legislation. Complex problems have arisen in western states utilizing both the riparian rights and prior appropriation doctrines. In these states, a riparian proprietor may choose either but not both of these theories. Both riparian and appropriative water rights may be acquired by prescription. Water rights in Louisiana are somewhat unsettled, but judicial decisions seem to look to the common law. (Heckerling-Florida)
W70-01137

WISCONSIN LAW OF WATERS,
For primary bibliographic entry see Field 04A.
W70-01138**RIPARIAN WATER RIGHTS V A PRIOR APPROPRIATION SYSTEM: A COMPARISON,**
For primary bibliographic entry see Field 06B.
W70-01139**RIPARIAN WATERS RIGHTS V A PRIOR APPROPRIATION SYSTEM: A COMPARISON,**
For primary bibliographic entry see Field 06B.
W70-01140**RIPARIAN WATER RIGHTS V A PRIOR APPROPRIATION SYSTEM: A COMPARISON,**
For primary bibliographic entry see Field 06B.
W70-01141

Field 06—WATER RESOURCES PLANNING

Group 6E—Water Law and Institutions

RIPARIAN WATER RIGHTS V A PRIOR APPROPRIATION SYSTEM: A COMPARISON,
For primary bibliographic entry see Field 06B.
W70-01142

THE NAVIGATION SERVITUDE AND JUST COMPENSATION: STRUGGLE FOR A DOCUMENT,
For primary bibliographic entry see Field 04A.
W70-01144

THE NAVIGATION SERVITUDE AND JUST COMPENSATION: STRUGGLE FOR A DOCUMENT,
For primary bibliographic entry see Field 04A.
W70-01145

STOUDER V DASHNER (DOMINANT VERSUS SERVIENT LAND RIGHTS RELATING TO DRAINAGE OF SURFACE WATERS).
For primary bibliographic entry see Field 04A.
W70-01146

ROCKLAND COUNTY ANTI-RESERVOIR ASS'N V DURYEA (PREVENTION OF RESERVOIR CONSTRUCTION).
For primary bibliographic entry see Field 04A.
W70-01147

FISH (LICENSES AND PERMITS).

Ill Ann Stat ch 56, secs 225-242 (Smith-Hurd 1967), as amended, (Supp 1969).

Descriptors: *Illinois, *Regulation, *Fish, *Permits, Legislation, Commercial fishing, Sport fishing, Fishing gear, Mussels, State jurisdiction, State governments, Administrative agencies, Control, Legal aspects, Interstate compacts.

Fishing licenses are issued only upon application. Penalties are provided for violation of this provision. Fees for resident and non-resident licenses are set. The Department of Conservation may enter into reciprocal fishing agreements with Missouri, Iowa, and Indiana to permit persons licensed by these states to fish in any of the running waters forming a boundary between such states and Illinois. Resident retail fish dealers and wholesale dealers must procure a license. All licenses issued to retail fish dealers are valid only in the location described on the license application. To catch mussels and to engage in fish taxidermy also requires a license, as does the breeding of fish. Any person who desires to establish a fee fishing pond must apply for a license. The holder of the license must require all fishermen in such pond to register daily. Permits for the collection of fish for scientific purposes are granted. (Moulder-Florida)
W70-01148

OFFENSES AGAINST PROPERTY BY FORCE.
Ky Rev Stat Ann sec 433.330 - 433.360, 433.410, 433.710, 433.760, 433.780, 433.757 (1963), as amended, (Supp 1968).

Descriptors: *Kentucky, *Damages, *Water pollution control, *Regulation, Bridges, Levees, Railroads, Fish, Fishing, Navigation, Dams, Locks, Reservoirs, Legislation, Drainage, Sewers, Boats, Pollution abatement.

Anyone obstructing, damaging, or destroying any salt works, levee, state operated bridge or ferry, railway lock, or dam shall be subject to imprisonment in the state penitentiary. Any person who fishes, disturbs, or destroys a private fish pond shall be punished criminally and shall be liable for treble damages. Anyone who destroys public property shall be criminally liable for a fine. Anyone operating as a residence any boat or shanty who ties up to private property without permission shall be subject to fine and imprisonment. Any person who lit-

ters or dumps refuse upon public waters shall be subject to a fine. (Darragh-Florida)
W70-01149

JURISDICTION OF COUNTY DRAINAGE BOARDS.
For primary bibliographic entry see Field 04A.
W70-01150

OBSTRUCTION AND POLLUTION OF WATERS.
For primary bibliographic entry see Field 05G.
W70-01151

CONSTRUCTION, OPERATION, AND MAINTENANCE OF TOLL BRIDGES OVER PEARL RIVER.
Miss Code Ann secs 8447-51 thru 8447-68 (Supp 1968).

Descriptors: *Mississippi, *Bridges, *Local governments, *Bridge construction, Financing, State governments, Legislation, Legal aspects, Right-of-way, Easements, Condemnation, Eminent domain, Riparian lands, Beds under water, Federal government, Construction costs, Bridge design.

The legislature has declared that construction of additional bridges across the flood plain of the Pearl River will promote the economic development of the state, and the general welfare of the people. Any county bordering on the Pearl River is authorized to construct and maintain toll bridges across the river and/or its flood plain. The county may issue bridge revenue bonds to defer costs, may act jointly with other counties, and may enter agreements with federal or other governing agencies to further construction or financing. The county engaged in construction of a bridge under this act may purchase such lands, rights-of-way, easements in lands under water, and riparian lands or may acquire such lands and servitudes by eminent domain. (Kelly-Florida)
W70-01152

FLOOD CONTROL.
For primary bibliographic entry see Field 04A.
W70-01153

SILVER BLUE LAKES APARTMENTS V SILVER BLUE LAKE HOME OWNERS ASS'N INC (UNREASONABLE USE OF ARTIFICIAL WATERBODY).
For primary bibliographic entry see Field 04A.
W70-01154

NEW JERSEY TURNPIKE AUTHORITY V SISSELMAN (CONDEMNATION OF RIPARIAN LAND).
106 NJ Super 358, 255 A2d 810-817 (1969).

Descriptors: *New Jersey, *Condemnation, *Bridge construction, *Riparian land, Judicial decisions, Legislation, Federal government, Rivers and Harbors Act, Canals, Highways, State governments, Administrative agencies, Projects.

Plaintiffs brought suit to have certain property owned by defendant condemned in the public interest so that a highway spur might be built from the existing turnpike. The project was expressly authorized by the legislature. Defendant contended that the taking violated the Federal Harbors and Rivers Act and that the Authority had failed to comply with the requirements of a state statute. The land in question was needed for the construction of two bridges over a canal. Under the federal act any construction must be approved by the Corps of Engineers. The Turnpike Authority had applied for approval but had not received it when construction on the bridges began. Under the state statute, any public project must be referred to a planning board for review which the Authority

failed to do. After reviewing the statutes the court upheld the denial of an injunction against the condemnation by the Authority. The court held that the Authority had complied with both statutes. Under the federal act, since no construction had begun on an unapproved bridge, the statute had not been violated. The court also held that the state statute did not apply once the legislature had authorized the project. (Heckerling-Florida)
W70-01155

WATER RESOURCES.
For primary bibliographic entry see Field 04B.
W70-01156

PEARL RIVER BASIN DEVELOPMENT DISTRICT ACT.
For primary bibliographic entry see Field 06B.
W70-01157

PEARL RIVER BASIN DEVELOPMENT DISTRICT ACT.
For primary bibliographic entry see Field 06B.
W70-01158

PEARL RIVER BASIN DEVELOPMENT ACT.
For primary bibliographic entry see Field 06B.
W70-01159

FISHING, HUNTING, TRAPPING PERMITS.
Va Code Ann secs 29-51 thru 29-53, 29-55 thru 29-55.2, 29-55.4, 29-57 thru 29-60, 29-77.1 (1969).

Descriptors: *Virginia, *Permits, *Administrative agencies, *Wildlife management, Legislation, Hunting, Fishing, Trapping, National parks, Fish stocking, Fisheries, Fish conservation, Wildlife conservation, Recreation, Regulation, Legal aspects.
Identifiers: Licenses.

All persons must have permits to hunt, fish, or trap in this state, except that no permit is required for landowners on their own lands, residents under sixteen or over seventy on private lands in the county of residence, or Indians residing on reservations. Permits are available to state residents, landowners with at least four months residence, members of the armed forces in this state, and students in preparatory schools, colleges, or universities in this state. Non-residents must purchase a non-resident license. Special licenses are required to fish in waters stocked by the Commission of Game and Inland Fisheries and in the waters of the Shenandoah National Park and the Blue Ridge Parkway. Holders of trip fishing permits cannot fish in trout streams or waters stocked by the Commission. (McDonough-Florida)
W70-01160

FISH, OYSTERS, SHELLFISH, AND OTHER MARINE LIFE: MARINE RESOURCES COMMISSION AND COMMISSIONER OF MARINE RESOURCES.
For primary bibliographic entry see Field 03E.
W70-01161

MARINE RESOURCES COMMISSION.
For primary bibliographic entry see Field 03E.
W70-01162

SURVEYS OF AND RIGHTS IN OYSTER GROUNDS.
For primary bibliographic entry see Field 03E.
W70-01163

LEASING OYSTER-PLANTING GROUNDS.
For primary bibliographic entry see Field 03E.
W70-01164

WATER RESOURCES PLANNING—Field 06

Water Law and Institutions—Group 6E

TRANSFER OF OYSTER-PLANTING LEASES;

RIGHTS OF RIPARIANS.

For primary bibliographic entry see Field 03E.

W70-01165

CULLING OYSTERS.

For primary bibliographic entry see Field 03E.

W70-01166

FISH LAWS.

Va Code Ann secs 29-148 thru 29-153 (1969).

Descriptors: *Virginia, *Fish, *Fish management, *Fishing, Legislation, Legal aspects, Regulation, Herrings, Mullets, Bass, Trout, Perches, Streams, Rivers, Fish reproduction, Fish conservation, Dams, Fish ladders, Watercourses (Legal), Fish barriers, Navigation, Water pollution, Damages, Fish stocking, Fish hatcheries, Administrative agencies.

Identifiers: *Inland waters, *Fish wheels, *Game fish, Shad, Penalties (Criminal).

Until otherwise provided by a regulation of the Commission of Game and Inland Fisheries, it shall be unlawful for any person to take any fish in inland waters other than shad, herring, or mullet except by fishing with a hook and line or rod and reel. It is likewise unlawful to possess any species of bass or trout except as specifically provided. It is lawful to sell trout which have been propagated and raised in a hatchery. The open season during which it will be lawful to take bass and trout by specified lawful methods will be as promulgated by Commission regulations. Owners and lessees of private ponds may take fish therefrom for personal use at any time. Any dam or other barrier in a watercourse which obstructs navigation or the passage of fish will be deemed a nuisance unless useful to the public and permitted by law or court order. Owners of obstructions to the free passage of fish will provide such obstructions with fish ladders. Fish wheels may be operated in the ponds of this state for the purpose of restocking such ponds. It is unlawful, with specified exceptions, to use any substance for the destruction of fish or to place any noxious substance in any watercourse. (Keith-Florida)

W70-01167

OWNERSHIP OF BEDS.

Va Code Ann secs 62.1-1 thru 62.1-3 (1968).

Descriptors: *Virginia, *Beds, *Ownership of beds, *Riparian rights, Legislation, Legal aspects, Bays, Rivers, Shores, Jurisdiction, Fishing, Shellfish, Low water mark, Boundaries (Property), Maps, Dam construction, Navigation, Flood control, Erosion control, Sea walls, Jetties, Docks, Marinas, Easements, Permits, Leases, Surveys, Sewerage, Administrative agencies, Bulkhead line.

Identifiers: *Marine resources, *Riparian owners.

All of the unconveyed beds of bays, rivers, creeks, and the shores of the sea within the jurisdiction of the state will continue and remain the property of the state. Such beds, and shores may be used by the people of the state for fishing and the taking of shellfish, subject to state law. The limits or bounds of land lying on bays, rivers, creeks, and shores, and the rights and privileges of the owners of such land, will extend to low water mark only. An exception exists where a creek or river has been conveyed by a special grant or compact. It is unlawful to trespass or encroach upon or take or use any materials from the beds of bays, rivers, creeks, and sea shores which are state property without first obtaining authority from the Marine Resources Commission, except for: (1) authorized dam construction; (2) uses of beds authorized under different code provisions; (3) approved construction of navigation and flood control projects; (4) seawalls and jetties for erosion control; (5) docks and landings for non-commercial use; (6) fills by riparian owners to their established bulkhead line; (7)

facilities for public use or facilities owned or operated by any public service corporation; and (8) other uses authorized by the state legislature. The method of obtaining special permission from the Marine Resources Commission is specified. (Keith-Florida)

W70-01168

Descriptors: *Virginia, *Eminent domain, *Riparian rights, *hydroelectric power, Condemnation, Compensation, Public utilities, Public lands, Dams, Reservoirs, Electric power production, Riparian land, Riparian waters, Flow, Highway relocation, Legislation, Legal aspects, Damages.

Identifiers: *Public service corporation.

Public service corporations producing hydroelectric power for public sale have the right of eminent domain. This right may be exercised to acquire all necessary lands, property, or rights including lands held for public or private, religious, charitable, educational, or cemetery purposes. Eminent domain is not available as against public-carrier railroads or any streets or alleys in municipalities. In the event of condemnation of roads or bridges, compensation and damages will include the cost of relocation and reconstruction. Riparian owners may be compensated for loss of water flow downstream caused by corporation facilities. (McDonough-Florida)

W70-01176

GENERAL PROVISIONS OF THE STATE WATER CONTROL LAW.

For primary bibliographic entry see Field 05G.

W70-01169

POWERS AND DUTIES OF THE STATE WATER CONTROL BOARD.

For primary bibliographic entry see Field 05G.

W70-01170

REGULATION OF SEWAGE DISCHARGE.

For primary bibliographic entry see Field 05G.

W70-01171

PENALTIES FOR POLLUTION AND POLLUTION FROM BOATS.

For primary bibliographic entry see Field 05G.

W70-01172

INTERSTATE COMMISSION ON THE POTOMAC RIVER BASIN.

For primary bibliographic entry see Field 05G.

W70-01173

OHIO RIVER VALLEY WATER SANITATION COMMISSION.

For primary bibliographic entry see Field 05G.

W70-01174

WATER-POWER DEVELOPMENT, CONSERVATION OF HYDROELECTRIC POWER DAMS AND WORKS.

Va Code Ann secs 62.1-80, 62.1-82, 62.1-83, 62.1-85, 62.1-90, 62.1-91, 62.1-95 (1968).

Descriptors: *Virginia, *Hydroelectric power, *Hydroelectric project licensing, *Dam construction, Hydroelectric plants, Electric power, Electric powerplants, Powerplants, Dams, Electric power industry, Electric power production, Water utilization, State governments, Federal government, Administrative agencies, Obstruction to flow, Navigable waters, Navigation, Regulation, Eminent domain, Riparian rights, Permits, River regulation.

The Water Power Act is to encourage water power development in Virginia. The State Corporation Commission controls and regulates such development. Nothing herein deprives any riparian owner of existing rights. No hydroelectric dam may be constructed across waters of the state unless such dam complies with the provisions of this Act. Persons proposing to construct dams must first obtain a license from the Commission. The Commission may reject license applications, require the modification of dam plans before issuing such license and may establish the terms and conditions thereof. Dams must not unreasonably obstruct navigation or stream flow, and where such dam is to be located across navigable waters of the United States the owner must make such provisions for navigation as are required by the Secretary of the Army. The value of a license must not be estimated in any valuation for rate making or for the acquisition by the state of property included in any licensed development. (Marsee-Florida)

W70-01175

RIGHT OF EMINENT DOMAIN OF PUBLIC SERVICE CORPORATIONS.

Va Code Ann sec 62.1-98 (1968).

SURFACE RUNOFF AND FLOODWATER DIVERSION.

For primary bibliographic entry see Field 04A.

W70-01177

MILLS, DAMS, AND CERTAIN OTHER WORKS ON WATERCOURSES.

For primary bibliographic entry see Field 04A.

W70-01178

FEDERAL WATER RESOURCES DEVELOPMENT.

For primary bibliographic entry see Field 06B.

W70-01179

IMPROVEMENT OF NAVIGABILITY OF STREAMS.

For primary bibliographic entry see Field 04A.

W70-01180

DREDGING SAND AND GRAVEL AND MISCELLANEOUS OFFENSES (WATER POLLUTION).

For primary bibliographic entry see Field 05G.

W70-01181

DUTIES OF DIRECTOR OF PUBLIC WORKS.

For primary bibliographic entry see Field 04A.

W70-01182

CONSTRUCTION OF PORT FACILITIES.

For primary bibliographic entry see Field 04A.

W70-01183

OBSTRUCTIONS TO NAVIGATION.

For primary bibliographic entry see Field 04A.

W70-01184

STAKES AND BUOYS.

R I Gen Laws Ann secs 46-7-1 thru 46-7-6 (1956).

Descriptors: *Rhode Island, *Buoys, *Channels, *Navigation, Bays, Rivers, Legislation, Administrative agencies, State governments, Federal government, Legal aspects, Navigable rivers, Navigable waters, Admiralty, Lighthouses, Oceans, Warning systems, Governments.

The Director of Public Works shall accurately mark the channel of the Pawtucket River by erecting suitable stakes and buoys along the sides of said channel at the request of persons interested in the navigation of the River. Penalties are provided for the misuse of injury to such channel markers. The proper venue for such offenses is designated as well

Field 06—WATER RESOURCES PLANNING

Group 6E—Water Law and Institutions

as the statute of limitations on the bringing of such action. (MarseenFlorida)
W70-01185

RHODE ISLAND PILOTAGE REGULATION.
For primary bibliographic entry see Field 04A.
W70-01186

RHODE ISLAND WATER RESOURCES BOARD.
For primary bibliographic entry see Field 06D.
W70-01187

RHODE ISLAND WATER RESOURCES BOARD.
For primary bibliographic entry see Field 06D.
W70-01188

RHODE ISLAND WATER RESOURCES BOARD.
For primary bibliographic entry see Field 06D.
W70-01189

RHODE ISLAND WATER RESOURCES BOARD.
For primary bibliographic entry see Field 06D.
W70-01190

NEW ENGLAND INTERSTATE WATER POLLUTION CONTROL COMMISSION.
For primary bibliographic entry see Field 05G.
W70-01191

WATER POWER AND RESOURCES.
For primary bibliographic entry see Field 06B.
W70-01192

SHELLFISH TRANSFER AND TAKING.
R I Gen Laws Ann secs 20-11-14 thru 20-11-19
1968.

Descriptors: Rhode Island, Shellfish, Commercial shellfish, Fish harvest, Clams, Commercial fish, Public health, Aquiculture, Fish conservation, Water conservation, Legal aspects, Administrative agencies, Legislation, Fisheries, Fish management, Fishing gear, Regulation, Supervisory control, Power, Control.
Identifiers: PenaltiesCriminal.

The Director of Natural Resources is authorized to transfer shellfish from uncertified state waters to approved areas. The Director may make regulations governing the reharvest of such shellfish after taking all necessary safeguard to insure their cleanliness. Those areas to which the shellfish are transferred must be marked out, and dredging or tonging on them except under the direction of the Director is prohibited. The costs of transferring shellfish shall be met through the sale of shellfish. The possession, taking, and sale of soft-shelled clams is regulated herein including minimum size limits. This Act provides penalties for the improper taking of transferred shellfish. Marsee-Florida
W70-01193

REGULATION OF LOBSTER FISHERIES.

R I Gen Laws Ann secs 20-12-1, 20-12-2, 20-12-6
thru 20-12-11 1968.

Descriptors: Rhode Island, Lobsters, Commercial shellfish, Commercial fishing, Fish harvest, Regulation, Administrative agencies, Water conservation, Legal aspects, Legislation, State governments, Fisheries, Fish conservation, Crustaceans, Animals, Permits, Jurisdiction, Buoys.
Identifiers: Lobster pots.

In regulating the taking of lobsters from waters within the jurisdiction of Rhode Island, this Act contains provisions relating to 1 license requirements for the taking of lobsters; 2 procedures and regulations for the issuance of licenses; 3 the power of the Department of Natural Resources to require of licensees reports on lobster taken; 4 the minimum size of lobsters taken; 5 the unlawfulness of possessing egg-bearing female lobsters; 6 the buoying of pots; 7 the marking of buoys, pots, and other contrivances; 8 the unauthorized raising of pots; and 9 the unlawfulness of mutilating uncooked lobsters. Marsee-Florida
W70-01194

REGULATION OF SCALLOP FISHERIES.

R I Gen Laws Ann secs 20-13-1 thru 20-13-7, 20-13-10 thru 20-13-13, 20-13-17 1968.

Descriptors: Rhode Island, Shellfish, Commercial shellfish, Commercial fishing, Fishing, Fish harvest, Regulation, Legislation, Permits, Administrative agencies, Water conservation, Legal aspects, State governments, Aquiculture, Fisheries, Farm ponds, Fish reproduction, Fish management, Fish conservation, Water farming.
Identifiers: Scallops.

In regulating the taking of scallops in Rhode Island waters, this Act contains provisions relating to 1 the taking of scallops at night; 2 maximum daily take without a license; 3 open and closed seasons; 4 the issuance of licenses for the taking of scallops; 5 the taking of scallops stranded on the shore; 6 the sale of scallops during closed season. Ponds are designated in which only hand-drawn dredges or appliances may be used. The Director of Natural Resources, in order to insure the future of the scallop industry, is responsible for transplanting seed scallops from endangered areas to more favorable locations in the state. Marsee-Florida
W70-01195

6F. Nonstructural Alternatives

EVALUATION OF BENEFITS OF A FLOOD WARNING SYSTEM.
Carnegie-Mellon Univ., Pittsburgh, Pa.; Systems Planning Associates, Pittsburgh, Pa.; and Weather Bureau, Pittsburgh, Pa.
For primary bibliographic entry see Field 06B.
W70-00838

6G. Ecologic Impact of Water Development

CHALLENGES TO CREATIVE CONSERVATION,
Colorado State Univ., Fort Collins.
Robert E. Dils.
J Soil Water Conserv, Vol 24, No 2, p 44-47, Mar-Apr, 1969. 4 p.

Descriptors: *Conservation, *Natural resources, Environment, *Ecology, Recreation, Creativity, Landscaping, Environmental engineering, Social values, Land management, *Land resources, City planning.
Identifiers: Landscapes, Professional development.

Despite a knowledge revolution in the last decade, challenges in all disciplines, including conservation, are greater today than ever before. The challenges are social, personal, professional, and technical; they apply to the experienced conservationist and to the neophyte. Six challenges that conservationists must overcome if a better life is to be created are: (1) the need to create and re-create a quality environment; (2) the ecology of leisure; (3) conservation of citysheds (synonymous with megalopolis); (4) landscape creativity; (5) cooperation in conservation; and (6) bringing

minority groups into conservation. Conservationists must not be stereotyped as reserved, dedicated, well-trained scientists who maintain the status quo. They must be interested, involved, and creative in every facet of their work. Today's college graduate is well equipped in terms of education; with the modern tools, dollars, and facilities at his disposal, he is far better qualified than his counterpart a generation or two ago to create a better life for all. (USBR)
W70-01081

07. RESOURCES DATA

7A. Network Design

MEASURING RAINFALL ON FOREST CATCHMENTS,
Monash Univ., Clayton (Australia). Dept. of Mechanical Engineering.
For primary bibliographic entry see Field 02B.
W70-00843

7B. Data Acquisition

SEASONAL VARIATION IN RAIN GAGE CATCH,
Agricultural Research Service, Cochocton, Ohio. Soil and Water Conservation Research Div.; and Weather Bureau, Akron, Ohio. Eastern Region.
For primary bibliographic entry see Field 02B.
W70-00854

USE OF MEMBRANE FILTERS IN GRAVIMETRIC ANALYSES OF PARTICULATE MATTER IN NATURAL WATERS,
Dartmouth Coll., Hanover, N. H.; and Yale Univ., New Haven, Conn.
John S. Eaton, Gene E. Likens, and F. H. Bormann. *Water Resources Res*, Vol 5, No 5, p 1151-1156, Oct 1969. 6 p, 4 fig, 1 tab, 7 ref.

Descriptors: *Filtration, *Analytical techniques, *Water analysis, *Gravimetric analysis, Weight, Adsorption, Drying, Temperature, Absorption.
Identifiers: Millipore filters.

The weights of membrane filters used in gravimetric analysis of water were significantly changed by electrostatic charge, leachable material within the filters, and absorption of atmospheric moisture. Millipore type HA filters lost an average of about 0.32% of their dry weight as leachable material when 6 liters of distilled water were filtered. About 165 ml were required to remove 50% of the total leachable material removed by 1000 ml. These filters absorbed moisture from the atmosphere very rapidly during the first minute of exposure and at a much slower rate thereafter. The leachable material contributed to moisture absorption. Desirable drying temperature and time for Millipore type HA filters was determined. Other filters were compared: recommendations for the use of these filters are given. (Knapp-USGS)
W70-00857

A NUMERIC METHOD FOR ESTIMATING INFILTRATION, REDISTRIBUTION, DRAINAGE, AND EVAPORATION OF WATER FROM SOIL,
Utah State Univ., Logan; Illinois Univ., Urbana; and Colorado State Univ., Fort Collins.
For primary bibliographic entry see Field 02G.
W70-00862

A STUDY OF HOT WIRE AND HOT FILM ANEMOMETERS IN WATER (FRENCH),
Centre National de la Recherche Scientifique, Marseille (France); and Aix-Marseille Univ. (France). Institut de Mecanique des Fluides. F. Resch, and M. Coantic. English summary. *La Houille Blanche*, No 2, p 151-161, 1969. 17 fig, 21 ref.

Descriptors: *Instrumentation, *Turbulent flow, *Velocity, *Anemometers, *Flow measurement, Calibrations, Conduits, Engineering structures, Fluctuation, Cooling.

Identifiers: *Hot wire anemometer, *Hot-film anemometers, Circular conduits.

Methods of the measurement of mean and fluctuating components of velocity in turbulent flow of water using hot-film or hot-wire anemometers were investigated. A circulating water loop of circular flow cross-section and specially designed probes were built. New refinements of measuring and calibrating techniques were developed. This applied particularly to hot films of conical shape for which a dimensionless cooling law is proposed. Measurements of turbulence intensities and spectra along the axis of a circular conduit were obtained with an accuracy which compared favorably with that of measurement in dynamically similar air flows. (Carstea-USGS)

W70-00868

DETECTION OF CAVITATION BY ACOUSTIC AND VIBRATION-MEASUREMENT METHODS,
Technical Univ. of Budapest (Hungary). Dept. of Hydraulic Machinery.

For primary bibliographic entry see Field 08B.

W70-00875

THE RELATIONSHIP BETWEEN THE ULTIMATE RESISTIVITY OF CLAYEY SANDSTONES AND THEIR POROSITY AND CLAY CONTENTS (RUSSIAN),

Vsesoyuznyi Nauchno-Issledovatel'skii Institut Geofizicheskikh Metodov Razvedki, Moscow (USSR).

D. A. Mel'nikov.

Prikladnaya Geofizika, No 3, p 149-159, 1968. 3 fig, 2 tab, 8 ref.

Descriptors: *Electrical resistance, *Sandstones, *Clays, *Porosity, *Resistivity, Electrical well logging, Petrology, Sedimentary rocks, Sands, Pores, Boreholes, Mathematical studies.

Identifiers: *USSR, Terek and Kuma River basins, Resistivity-porosity-clay relationship.

The resistivity-porosity-clay content relationship was analytically and experimentally studied using borehole data of sandstones of the Kuma and Terek River basins, USSR. The ultimate resistivity depends on both the porosity and clay content. Comparison of the mathematical equations with experimental data gave satisfactory results. (Gabriel-USGS)

W70-00876

ESTIMATION OF CLAY CONTENT OF SAND FORMATIONS FROM WELL-LOGGING DATA (RUSSIAN),

Vsesoyuznyi Nauchno-Issledovatel'skii Institut Geofizicheskikh Metodov Razvedki, Moscow (USSR).

S. P. Kamenev.

Prikladnaya Geofizika, No 3, p 142-148, 1968. 2 fig, 5 ref.

Descriptors: *Clays, *Sands, *Sedimentary rocks, *Gamma rays, *Exploration, Porosity, Wells, Boreholes, Electrical well logging, Mathematical studies.

Identifiers: Gamma-ray logging.

The application of gamma-ray logging for the determination of clay content in sandy formations was investigated on the basis of analytical and experimental studies in gas- and oil-bearing formations at the depth of 1880-1890 m. The use of gamma-ray logging yields better interpretation of electrical well-logging data and, moreover, the gamma-ray method does not require the construction of standard curves for the determination of clay content. An equation is given for evaluating volumetric clay content. (Gabriel-USGS)

W70-00877

ON THE POSSIBILITY OF ESTIMATING THE THICKNESS OF UNCONSOLIDATED ROCKS BY VERTICAL ELECTRICAL SOUNDING IN PERMAFROST AREAS (RUSSIAN),
Vsesoyuznyi Nauchno-Issledovatel'skii Institut Geofizicheskikh Metodov Razvedki, Moscow (USSR).

V. A. Kirillov, O. M. Kuvayev, L. M. Syuzumov, and V. S. Yakupov.

Prikladnaya Geofizika, No 3, p 99-107, 1968. 2 fig, 1 tab, 5 ref.

Descriptors: *Sedimentary rocks, *Permafrost, *Electrical studies, *Exploration, Geophysics, Petrology, Seasonal, Electrical conductance, Density, River basins, Temperature, Surveys.

Identifiers: *Northeastern USSR, Electrical prospecting.

After a detailed critical analysis of the use of electrical prospecting methods in permafrost areas, a successful application of the vertical electrical methods for the determination of thickness of poorly-consolidated formations in the permafrost areas of the Berelekh, Delyankir, Khudzhakh, and Malyk-Sienya River basins of northeastern Siberia is described. Some definite suggestions to improve the interpretation and the scope of application of the electrical prospecting method are also given. (Gabriel-USGS)

W70-00878

DIGITIZED PHYSICAL DATA OF A RANGE LAND WATERSHED,

Agricultural Research Service, Boise, Idaho. Northwest Watershed Research Center; and Agricultural Research Service, Beltsville, Md. Hydrograph Lab.

For primary bibliographic entry see Field 07C.

W70-00993

ON A SOIL AND GROUND WATER INVESTIGATION WITH THE SHALLOW REFRACTION METHOD AT MO I RANA,
Terratest A.B., Bromma (Sweden); and Swedish Geotechnical Inst., Stockholm.

B. Sjogren, and O. Wager.

Eng Geol, Vol 3, No 1, p 61-70, Jan 1969. 10 p, 7 fig, 6 ref.

Descriptors: *Seismic studies, *Geophysics, *Surveys, *Groundwater, Stratigraphy, Foundation investigations, Aquifers, Soil investigations, Water levels, Sands, Clays.

Identifiers: *Norway, Mo i Rana (Norway), Groundwater prospecting.

The shallow seismic refraction method—for more than 20 years well known as an useful tool for planning of dam sites, tunnels, roads and other construction works—has, during the last ten years also proved to be an excellent method to locate water-bearing fissured zones in bedrock, hidden by overburden. Furthermore, the method can be successfully applied to establish occurrence of different layers within the overburden. Seismic investigations at Mo i Rana, Norway, illustrate how a reliable picture of the subsurface conditions in an area with sand and clay deposits can be obtained with help of the fast seismic method. Also shown is the possibility of determining groundwater levels and directions of water flow. (Knapp-USGS)

W70-00995

AN INEXPENSIVE SHALLOW WATER TABLE PROBE,

Agricultural Research Service, Tucson, Ariz. Southwest Watershed Research Center.

Fred Libby.

J Geol, Vol 77, No 5, p 626-628, Sept 1969. 3 p, 1 fig.

Descriptors: *Water levels, *Water table, *Groundwater, *Measurement, *Instrumentation, Sampling, Water measurement, Test procedures.

Identifiers: Groundwater level probe.

A method for rapidly determining shallow ground-water levels in sand and gravel profiles has been developed by the U.S. Department of Agriculture. By this method, an investigator can accurately determine depths to groundwater in a few minutes by direct measurement. The unit works in locations where the water table is almost 12 ft beneath the surface. The equipment required is simple, portable, and easily handled. It consists of a 13-ft-long, 3/8-inch-diam steel rod and driving ram. The steel rod has one-sixteenth of an inch holes drilled through it at 6-inch intervals. Couplings are of an electrical conduit type so that connections can be made without using wrenches. The rod is driven into the ground to its entire length with the driving ram and then extracted by hand. Upon extraction, the 6-inch-interval holes in the rod are examined to see which is the uppermost hole that contains water. This system for measuring shallow depths to the water table was used successfully on 2 consumptive-use surveys along the major length of the Santa Ynez River in California. (Knapp-USGS)

W70-00996

TIME VARIANT GROUND WATER FLOW BY RESISTANCE NETWORK ANALOGUES,
Birmingham Univ. (England). Dept. of Civil Engineering.

For primary bibliographic entry see Field 02F.

W70-01039

PHOTOGRAMMETRIC MEASUREMENT OF ROCK SURFACES IN A POWER TUNNEL,
Imperial Coll. of Science and Technology, London (England); Binnie and Partners, London (England); and Fairey Surveys Ltd. (Gr. Brit.).

D. E. Wright, D. E. Cox, and O. W. Cheffins. Water Power, Vol 21, No 6, 7, p 230-234, 274-279, June-July 1969. 11 p, 14 fig, 3 tab, 9 ref, append.

Descriptors: *Profiles, *Photogrammetry, *Tunnels, *Surveying, *Stereoscopic, *Roughness (Hydraulic), *Tunnel hydraulics, Photographic equipment, Water tunnels (Conveyance), Photography, Surveying instruments, Underground structures, Stereoscopic map plotters, Roughness (Hydraulic), Roughness coefficient, Surfaces, Cross-sections.

Identifiers: Ground-based photogrammetry, Photographic analysis, Malaysia.

A photogrammetric method was used for measuring the shape of a 16-ft-dia hydroelectric power tunnel in Malaysia. Stereoscopic photographs were taken with a 4 x 5 Linhof Super Technika having a 150-mm lens; data were plotted using a Zeiss Stereoplanoigraph C8. Professional photographic equipment can produce stereophotographs from which the position of the rock surface can be determined to an estimated accuracy of plus or minus 1/4 in. Over an area of 7 x 50 ft, control errors reduced the accuracy to plus or minus 1.3 in. Profiles can be plotted longitudinally or for cross sections. Details of the camera setup, surveying procedures, and plotting of data are given. (USBR)

W70-01090

EARTH RESOURCE SATELLITES,

Hawker Siddeley Dynamics Ltd., Hatfield (England).

G. K. C. Pardoe.

Sci J, Vol 5, No 6, p 58-67, June, 1969. 10 p, 10 fig, 5 ref.

Descriptors: *Aerial photography, Earth (Planet), Geology, Geography, Geologic investigations, Hydrology, Oceanography, Oceans, Maps, Land use, Surveys, Agriculture, Photographic equipment, Photographs, *Remote sensing, Resources, Resource development, *Natural resources, *Mapping, Sensors, *Reconnaissance surveys, Radar, *Satellites (Artificial).

Identifiers: Aerial reconnaissance, Airborne equipment, Airborne surveying, EROS (Acronym), Infrared photography.

Field 07—RESOURCES DATA

Group 7B—Data Acquisition

Communications, meteorological, and navigation control satellites may have a large impact in private and public sectors and may make large profits for the nations owning them, but of all the direct-application satellite systems envisioned, satellites for measuring the resources of the earth show the greatest promise of benefit to the world. The benefits will affect all mankind and will be manifest in terms of hard cash and in less direct ways that cannot be quantified in any detail. Study of these benefits shows that this will become a major application of satellite technology, and probably the greatest single direct use of space that can be foreseen. Advantages of satellite surveying include a continuous and regularly repeatable broad synoptic view of total earth cover over a long period, and low cost per unit of data collected. Sensors operating in different bands of the electromagnetic spectrum can measure a wide range of natural phenomena. Geologic, geographic, agricultural, and oceanographic applications are described. The equipment carried by satellites, handling of data, and administrative problems are discussed. Earth resource satellite programs in the U.S., the United Kingdom, and Europe are reviewed. (USBR) W70-01098

MULTISENSOR ANALYSIS FOR SOILS MAPPING,

Bureau of Public Roads, Washington, D.C.; and Purdue Univ., Lafayette, Ind.
Harold T. Rib, and Robert D. Miles.
Highw Res Board, Spec Rep 102, p 22-37, 1969. 17 p, 6 fig, 1 plate, 2 tab, 5 ref.

Descriptors: *Soil classifications, *Soil engineering, Data reduction, Field data, Soil moisture, Aerial photography, *Radar, Data collections, Field classifications, Infrared rays, *Photography, Sensors, Ultraviolet rays, Analysis, *Remote sensing, Mapping.
Identifiers: *Soil maps, *Infrared photography, Photointerpretation, Test results, Infrared imagery, *Radar images, *Color photography.

A study project was instituted at Purdue University to investigate the potential of aerial films and sensors for detailed soils mapping. The first phase of the project was evaluating the potential of available types of aerial sensors and proposing a multisensor system for performing detailed engineering soils mapping. Results of the first phase study are described. During investigation of the various sensors, 9 flight coverages were made over 3 controlled test sites during a 13-mo period. Coverage was obtained using: (1) color positive, color infrared, color negative, black-and-white panchromatic, and black-and-white infrared aerial films; (2) a 9-lease multiband camera; (3) K-band radar sensors; (4) far infrared sensors, and (5) an ultraviolet through far infrared multichannel sensor. Not all combinations were used in any one flight program, but several combinations were used during each flight. The optimum system for delineating and mapping soils is a multichannel sensor flown simultaneously with an aerial mapping camera taking natural color photographs. Natural color was the most useful single film type. (USBR) W70-01125

SURFACE AND SUBSURFACE EXPLORATION BY INFRARED SURVEYS,

Air Force Inst. of Tech., Wright-Patterson, AFB, Ohio; and Oklahoma State Univ., Stillwater.
R. V. Matalucci, and M. Abdel-Hady.
Highw Res Board, Spec Rep 102, p 1-12, 1969. 12 p, 13 fig, 19 ref.

Descriptors: *Aerial photography, Photography, *Infrared rays, Remote sensing, Sensors, *Infrared radiation, Instrumentation, Bibliographies, *Subsurface investigations, Pipelines, Planning, Locating, *Exploration, Mapping, Subsurface drainage, Geologic formations, Engineering geology, Reconnaissance surveys, Geologic mapping, Investigations.

Identifiers: *Infrared photography, Buried pipes, Photointerpretation, *Infrared detectors, Infrared imager, Infrared sensors, Infrared.

Basic principles relating to infrared radiation and demonstrating various applications of infrared photography and imagery to surface and subsurface exploration and terrain analysis for highway construction and other engineering projects are summarized. Infrared (IR) photography and imagery highlight variations in soil texture, composition, and moisture not usually recorded by conventional photography. The chlorophyll effect allows IR photography to assist in appraisal of cultivated land for right-of-way acquisitions. Hidden subsurface conditions and geological features of greatest importance during highway site selection and design, including mud pockets, underground cavities, volcanic and hydrothermal activities, subsurface drainage systems, and buried utilities and conduits can be exposed with IR instrumentation. Through further research in the techniques used for infrared remote sensing, surface and subsurface exploration and drainage studies for constructing highways, airports, and other projects may be greatly facilitated. (USBR)
W70-01128

STRENGTH TEST ON NEWLY FALLEN SNOW,

Forest Service (USDA), Salt Lake City, Utah. Alta Avalanche Study Center.

Ronald I. Perla.
USDA Forest Serv Res Note RM-150, 1969. 12 p.

Descriptors: *Snow, *Snow cover, *Snowpacks, *Measuring instruments, *Mechanical properties, On site tests, Shear stress, Strength, Physics.
Identifiers: Ram penetrometer, New snow, Drop cone penetrometer, Shear vane.

In situ strength tests previously applied to metamorphosed snow were modified to measure the mechanical properties of newly fallen snow during storms. A large drop cone penetrometer, protected from the wind by an aluminum shell, was used to determine snow 'hardness'. A lightweight model of the Haefeli ram penetrometer measured 'Ram Numbers'. Shear strengths were obtained from large, lightweight frames. Some preliminary tests were made with a shear vane driven by a torque wrench. A new technique was devised for measuring tensile strength: a cantilever beam of snow is undercut until it fails under its own weight. W70-01221

FIELD EVALUATION OF SEEPAGE MEASUREMENT METHODS,

Idaho Univ., Moscow; and Agricultural Research Service, Kimberly, Idaho. Snake River Research Center.

For primary bibliographic entry see Field 04A.

W70-01236

REVIEW OF METHODS FOR MEASURING AND PREDICTING SEEPAGE,

Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.

For primary bibliographic entry see Field 04A.
W70-01238

7C. Evaluation, Processing and Publication

CATAF SYSTEM CONTROLS FOR REGULATION OF COMBINED SEWAGE FLOWS,
Municipality of Metropolitan Seattle, Wash.; and Metropolitan Engineers, Seattle, Wash.
For primary bibliographic entry see Field 05D.
W70-00889

RECORDS OF SELECTED WELLS AND SPRINGS IN THE RULISON PROJECT AREA,

GARFIELD AND MESA COUNTIES, COLORADO,

Geological Survey, Denver, Colo.

Theodore R. Hurr, Woodrow W. Wilson, Frank A. Welder, and R. L. Emerson.
Geol Surv Open-file Rep, Sept 1969. 17 p, 1 fig, 1 plate, 3 tab, 3 ref. AEC Contract AT (29-2)-474.

Descriptors: *Data collections, *Hydrologic data, *Water wells, *Springs, *Colorado, Water levels, Water quality, Water yield.

Identifiers: Garfield County (Colo), Mesa County (Colo), Project Rulison, Well records.

An inventory of wells and springs in the Rulison project area and vicinity was made from March 20-April 3 and May 20-25, 1969, by the U S Geological Survey in cooperation with the U S Atomic Energy Commission. The project is an experimental study to determine the commercial feasibility of stimulating natural-gas production in the Rulison gas field by fracturing the resR. ERVOIR ROCITH A. NUCLÉAIR EXPLOSION. The nuclear device will be implanted approximately 8,400 ft below land surface. The purpose of the study was to document the physical condition of wells and springs, and to collect samples of water prior to the nuclear event, for chemical analyses. During the field inventory, all wells and springs within a 10-km (6.2-mi) radius of the emplacement hole and selected wells and springs within the 10-km to 20-km (12.4-mi) radius were visited. Records of the inventoried wells and springs are given in tables, and their locations mapped. (Knapp-USGS)
W70-00987

GROUNDWATER IN SANTA BARBARA COUNTY, CALIFORNIA, SPRING 1967 TO SPRING 1968,

Geological Survey, Menlo Park, Calif.

R. E. Lewis.
Geol Surv Open-file Rep, May 1969. 30 p, 12 fig, 3 tab, 4 ref.

Descriptors: *Data collections, *Hydrologic data, *Groundwater, *California, Water levels, Water wells, Water utilization, Water quality, Water yield, Water storage, Water level fluctuations.

Identifiers: *Santa Barbara County (Calif).

Precipitation for the 1968 water year at Santa Barbara and Santa Maria was generally lower than the long-term average. Groundwater pumping in the county was 307,000 acre-ft; this is an increase of 11,000 acre-ft over the amount estimated for the previous year but about equal to the annual average for the period 1963-67. Water levels were, on the average, slightly higher in most areas; as a result, estimates of change of groundwater in storage show a slight net increase over last year. In the Santa Maria Valley water level in one well in the southeastern part of the valley was about 86 ft higher, and groundwater in storage increased an estimated 176,000 acre-ft. Chemical analyses of water taken from wells during autumn 1967 show no significant change from analyses reported during the previous year, and there is no indication of intrusion of sea water in the coastal basins sampled. (Knapp-USGS)
W70-00989

DIGITIZED PHYSICAL DATA OF A RANGE-LAND WATERSHED,

Agricultural Research Service, Boise, Idaho. Northwest Watershed Research Center; and Agricultural Research Service, Beltsville, Md. Hydrograph Lab.

G. R. Stephenson, and C. B. England.
J Hydrol, Vol 8, No 4, p 442-450, Aug 1969. 9 p, 6 fig, 11 ref.

Descriptors: *Data collections, *Data processing, *Digital computers, *Range management, Water conservation, Mapping, Surveys, Geologic mapping, Distribution patterns, Hydrogeology, Photogrammetry, Terrain analysis, Topography.
Identifiers: Boise (Idaho), Reynolds Creek Experimental Watershed.

Digitizing and photogrammetric equipment can facilitate hydrologic studies by sampling mapped information and by reducing it from graphical to numerical form. Such digitized data lend themselves to mathematical and statistical treatments by use of computers. In addition, digitized information can be processed by a X-Y plotter to obtain terrain profiles. Digitizing, recording, and plotting equipment has been used for interpreting various physical land features of the earth. By drawing on the relationships between soils and other land features, an index of total porosity, or of water-holding capacity, has been developed for grouping soil mapping units on a rangeland watershed. Such a method of combining soils by using an overall index that is hydrologically significant can reduce computational complexity and increase efficiency in design of hydrologic experiments, thereby reducing their costs. Procedures are described for sampling and digitizing physical data and the consistency of physical relationships are evaluated preliminary to more exacting analyses. Data were collected in the Reynolds Creek Experimental Watershed by the Northwest Watershed Research Center, Boise, Idaho. (Knapp-USGS) W70-00993

LINEAR PROGRAMMING FOR HYDROLOGIC ANALYSES,
Michigan Univ., Ann Arbor.
For primary bibliographic entry see Field 02A.
W70-0099

COMPUTER PROGRAM FOR PLOTTING TIME DEPENDENT DATA WITH INSTRUCTION AND EXAMPLES,
Nebraska Univ., Lincoln. Dept. of Horticulture and Forestry.
K. W. Brown, and Norman J. Rosenberg.
OWRR Project A-001-NEBR. Nebr Univ Coll Agr and Home Econ, Agr Exper Sta Rep MP23, July 1969. 35 p, 5 fig.

Descriptors: *Computer programs, *Digital computers, *Data processing, Hydrologic data, Publications, Documentation, Technical writing, Data storage and retrieval.
Identifiers: Computer data-plotting, Data presentation.

The use of multichannel automatic data recorders has necessitated the development of techniques for rapid analysis and presentation of data. A computer program was developed to plot time dependent data from a storage matrix. The body of the program, entitled TIMEPLOT, is written in FORTRAN IV. To minimize the run time required, the input and output subroutines are written in F level COBOL. Time, which may range from 1 hour to 16 days, is plotted on the abscissa. The program computes the intervals at which labels are placed and determines the required annotation. Data may be plotted as frequently as one observation per minute or as infrequently as one observation per day. The ordinate may represent any parameter. A single parameter may be plotted or several parameters may be superimposed upon each other. Combinations may be arranged on a single time axis. The program was designed with special features to facilitate the plotting of microclimatic, micrometeorological, and other types of time-dependent data. Plots drawn in india ink may be photographically reduced for use in reports and journal articles. Associated utility programs are also described. (Knapp-USGS) W70-01008

ON THE PRESENT OPTIMUM VARIANT IN HYDROGEOLOGICAL EXPLORATION (GERMAN),
Central Geological Inst., Berlin (East Germany)
Hartmut Glander.
Zeitschrift fur Angewandte Geologie, Vol 14, No 9, p 459-465, Sept 1968. 4 fig, 13 ref.

Descriptors: *Hydrogeology, *Exploration, *Mapping, Groundwater, Aquifers, Petrography,

Rivers, Transmissivity, Water chemistry, Discharge (Water), Carbonates, Nitrates.
Identifiers: *Berlin, Germany.

After stating the purpose and the preliminary postulates of hydrogeological exploration and mapping, the author gives a few examples of mapping hydrogeological elements in the area southeast of Berlin. Two maps of 1:50000 scale give the distribution of groundwater and transmissivity characteristics in the area. (Gabriel-USGS) W70-01022

STOCHASTIC METHODS FOR ANALYZING RIVER BASIN SYSTEMS,
Cornell Univ., Ithaca, N.Y. Dept. of Water Resources Engineering.
For primary bibliographic entry see Field 06A.
W70-01085

INCREASES IN MAXIMUM STREAM TEMPERATURES AFTER SLASH BURNING IN A SMALL EXPERIMENTAL WATERSHED,
Forest Service (USDA), Portland, Oreg. Pacific Northwest Forest and Range Experiment Station. Al Levno, and Jack Rothacher.
USDA Forest Serv Res Note PNW-110, Aug 69. 7 p, illus.

Descriptors: *Water temperature, *Temperature, *Clearcutting, *Water quality, *Burning, Heated water, Watershed management, Coniferous forests, Land management, Streamflow, Oregon.
Identifiers: Experimental watersheds.

The first year after slash was burned on a 237-acre clearcut watershed in the Cascade Range of Oregon, average maximum water temperatures increased 13 deg, 14 deg, and 12 deg F. during June, July, and August. A maximum stream temperature of 75 deg F. persisted for 3 hours on a day in July. W70-01220

08. ENGINEERING WORKS

8A. Structures

ROLE OF PROGNOSIS OF GROUNDWATER STATE IN PROJECTION OF DAMS (POLISH),
Jan Flisowski.
English and Russian summaries. Przeglad Geol, Vol 17, No 7, p 347-352, 1969. 4 fig, 5 ref.

Descriptors: *Groundwater, *Reservoir leakage, *Dam design, *Water levels, Groundwater basins, Valleys, Rivers, Streamflow, Flooding, Water table, Water loss, Drainage systems, Engineering geology, Seepage, Water level fluctuations.
Identifiers: *Poland, Vistula River.

The effect of the projected Nowy Korczyn dam on the Vistula River, Poland, was investigated analyzing a river-drainage system-groundwater hydraulic scheme. The effect of groundwater ponding caused by dam construction on the development of a river valley depends not only on the height of river ponding, but also on the ponded water table in the near-dam reservoir. Water seepage can be determined on the basis of the preliminary forecasting studies of the immediate effect of river waters on groundwaters. If the near-dam reservoir is surrounded by side ramparts, the river valley is transformed into a depression area subject to severe inundations. (Gabriel-USGS) W70-00874

BRIDGES - BOUNDARY AND OTHER WATERS.
For primary bibliographic entry see Field 06E.
W70-00951

FINAL REPORT TO THE AMERICAN SOCIETY OF CIVIL ENGINEERS ON TASK 7 AND TASK 9 OF THE COMBINED SEWER SEPARATION PROJECT,
American Society of Civil Engineers, New York. Robert N. Bowen, and John G. Havens.
Available from Clearinghouse as PB-185 992 at \$3.00 in paper copy or \$0.65 in microfiche. National Sanitation Foundation, ASCE Combined Sewer Separation Project, Dec 1967. 55 p, 18 fig, 4 tab, 14 ref. FWPCA Program No 11020 EKO.

Descriptors: *Construction materials, *Material testing, *On-site tests, *Pressure conduits, *Specifications.

Identifiers: *Cleaning procedures, *Conduit installation, *Fittings, *Plowing method, *Pressure sewer arrangements, *Sewer-within-sewer, *Special tools.

Assistance was provided in connection with special field trial installations of flexible tubing inserted in building sewers. Materials were proposed for pushing or pulling through a building sewer and a methodology and necessary attachments and tools were recommended. Polyethylene and polybutylene tubing are recommended for use inside building sewers and copper tubing for use in open trenches. A saddle type of connection is recommended for connection of pressure tubing to street pressure conduits. Cast iron, PVC, asbestos cement, or ductile iron are recommended for pressure conduits. Experience with plowing of pressure pipe is reviewed. Reference is made to standard practice for trench installations, street crossings and thrust blocking. Two methods of cleaning hose pressure tubing are proposed. Six possible layouts of pressure conduits are discussed in terms of operation and maintenance. All six arrangements provide for routine rerouting of flow by exploiting a dual conduit configuration. (Tucher-ASCE) W70-01043

DEVELOP AND FIELD TEST METHOD OF INSTALLING PRESSURE CONDUITS IN COMBINED SEWERS,

American Society of Civil Engineers, New York.

Henry J. Kazienko.

Available from Clearinghouse as PB-186 005 at \$3.00 in paper copy or \$0.65 in microfiche. ASCE Combined Sewer Separation Project, Johns-Manville R and D Center, Dec 30, 1968. 38 p, 15 fig, 9 tab. FWPCA Program No 11020 EKO.

Descriptors: *Design, *On-site-tests, Epoxy resins, Pressure conduit.

Identifiers: *Development, *Polyester conduit hanger, Allowable load, Combined sewer.

This report describes laboratory development and testing of polyester molded hangers cemented to a sewer pipe crown. Polyester hanger material formulations, epoxy cement, and hanger dimensions are specified, and methods of installation given in detail. Test of the hanger to failure in the laboratory showed fracture in tension through the conduit ring, leaving the upper part bonded to the concrete sewer crown. The field installation of 100-ft. of 3-in. diameter PVC pipe filled with water was made in a 7-ft. sewer in Evanston, Ill., in cooperation with the Metropolitan Sanitary District of Greater Chicago. The installation was sound and unaffected when removed after 4 1/2 months. (Tucker-ASCE) W70-01044

REPORT ON PRESSURE SEWERAGE SYSTEM, SUMMER STREET SEPARATION STUDY AREA, BOSTON, MASSACHUSETTS,
American Society of Civil Engineers, New York; and Camp, Dresser and McKee, Boston, Mass.

Available from Clearinghouse as PB-186 000 at \$3.00 in paper copy or \$0.65 in microfiche. ASCE Combined Sewer Separation Project, Report Sept 1968. 82 p, 24 fig, 16 tab, 10 ref. FWPCA Program No 11020 EKO.

Field 08—ENGINEERING WORKS

Group 8A—Structures

Descriptors: *Cost analysis, *Design, Pressure conduit.
Identifiers: *Building plumbing separation, *Sewer separation, Boston (Mass), Gravity sewer, Sewage flow variations.

The report is one of three by consultants to study the design, estimate costs and evaluate the feasibility of the hypothetical application of the ASCE Project Scheme of pressure sewers for separation in representative combined sewer areas from layouts by the Project Staff. The Boston study considered the 53-acre gently sloping, heterogeneous commercial Summer Street Separation Study Area, including many buildings built in the late 1800's. The report describes the separation of building plumbing in detail in a typical three-quarter century old five story and basement commercial building 65-ft. by 145-ft. in plan, and estimates the cost of plumbing separation. Four alternative pressure sewer collection systems are indicated with plans and hydraulic profiles. Some systems included in-line main pumping stations. The least expensive complete pressure system, which did not include a main pumping station, is estimated to cost \$6,400,000 compared to the cost of a gravity separation system designed by the consultants, estimated to cost \$4,700,000. Both costs include costs of building plumbing separation, \$4,000,000 for the pressure system including communitors, wet walls and non-clog pumps, and \$2,000,000 for the gravity systems. (Tucker-ASCE)
W70-01051

COMBINED SEWER SEPARATION PROJECT, REPORT ON MILWAUKEE STUDY AREA.

American Society of Civil Engineers, New York; Greeley and Hansen, Chicago, Ill.

Available from Clearinghouse as PB-186 003 at \$3.00 in paper copy or \$0.65 in microfiche. ASCE Combined Sewer Separation Project Report, Dec 1968. 84 p, 12 fig, 10 tab, 11 ref. FWPCA Program No 11020 EKO.

Descriptors: *Annual costs, *Cost analyses, Design, Pressure conduit.
Identifiers: Building plumbing separation, Sewer separation, Gravity sewer, Milwaukee (Wis), Sewage flow variations, Storage-grinder-pump.

The report is one of three by consultants to study the design, estimate costs and evaluate the feasibility of the hypothetical application of the ASCE Project scheme of pressure sewers for separation in representative combined sewer areas from layouts by the Project staff. The Milwaukee study considered the 157-acre mainly dense residential, moderately sloping Prospect Avenue Study Area essentially built prior to 1930 with many buildings dating from before 1900. The report describes methods of building plumbing separation and indicates two alternative arrangements of pressure sewers with plans and a profile. Estimates of construction cost of each (\$3,225,000 and \$3,260,000) are compared with that of a conventional gravity system of separation designed by the consultant (\$2,195,000). Plumbing separation, included in the above, is estimated to cost \$912,000 for the gravity alternative and \$971,000 for the pressure alternatives, not including storage-grinder-pump units. (Tucker-ASCE)
W70-01052

SEPARATION OF COMBINED WASTEWATER AND STORM DRAINAGE SYSTEMS, SAN FRANCISCO STUDY AREA.

Brown and Caldwell, San Francisco, Calif.

Available from Clearinghouse as PB-186 001 at \$3.00 in paper copy or \$0.65 in microfiche. ASCE Combined Sewer Separation Project Report, Sept 1968. 81 p, 23 fig, 11 tab, 13 ref. FWPCA Program No 11020 EKO.

Descriptors: *Cost analysis, *Design, Pressure conduit.

Identifiers: *Building plumbing separation, *Sewer separation, Gravity sewer, Plumbing code, San Francisco (Calif), Storage-grinder pump.

The report is one of three by consultants to study the design, estimate costs and evaluate the feasibility of the hypothetical application of the ASCE Project Scheme of pressure sewers for separation in representative combined sewer areas from layouts by the Project staff. The San Francisco study considered the 323 acre predominantly residential, steeply sloping Laguna Street Sewer Service District, rebuilt since the 1906 fire. The report describes methods of building plumbing separation and indicates two alternative arrangements of pressure sewers, with plans and profiles. Estimates of construction cost of each (\$13,000,000 and \$13,350,000) are compared with that of a conventional gravity system of separation designed earlier by the City (\$8,800,000). Plumbing separation, included in the above, is estimated to cost about \$5,400,000 for the gravity method and about \$4,400,000 for the pressure method not including storage-grinder-pump units. (Tucker-ASCE)
W70-01053

OUTLINE DESCRIPTION OF ASCE PROJECT ON 'SEPARATION OF SANITARY SEWAGE FROM COMBINED SYSTEMS OF SEWERAGE'.

American Society of Civil Engineers, New York.

Available from Clearinghouse as PB-185 995 at \$3.00 in paper copy or \$0.65 in microfiche. ASCE Combined Sewer Separation Project, Technical Memorandum No 1, Feb 21, 1966. 9 p, 2 fig, 1 ref. FWPCA Program No 11020 EKO.

Descriptors: *Pressure conduits.
Identifiers: *Combined sewers, Commminated sewage, Sewer separation.

Descriptions of the project separation scheme, project goal and project background are given. The general concept of the ASCE Project scheme is to pump comminated sanitary sewage from individual buildings and building complexes through relatively small pressure tubing laid in existing building connections and thence into new pressure conduits suspended in existing street sewers. Potential advantages of the scheme are discussed. The ultimate goal of the Project is to develop feasible designs and operations and to put them to test in actual systems. The immediate objective is to examine and evaluate both the feasibility and probable cost. The background of the project is reviewed. Dr. Gordon M. Fair conceived the scheme on which the Project is based. An appendix summarizes the need for separation of combined sewerage systems and the national scope of the problem. (Tucker-ASCE)
W70-01054

STUDY OF APPROXIMATE LENGTHS AND SIZES OF COMBINED SEWERS IN MAJOR METROPOLITAN CENTERS.

American Society of Civil Engineers, New York.

Dasel E. Hallmark, and John G. Hendrickson.
Available from Clearinghouse as PB-185 999 at \$3.00 in paper copy and \$0.65 in microfilm. ASCE Combined Sewer Separation Project, Technical Memorandum No 4, May 1, 1967. 9 p, 2 tab. FWPCA Program No 11020 EKO.

Descriptors: *Sewers.
Identifiers: *Combined sewers, *Sewer sizes, *Combined sewer lengths, Walk-through sewers.

A tabulation is given for five major cities of mileage and percentage of combined sewers with heights: greater than 48 inches; equal to or less than 48 inches; and equal to or less than 24 inches. An average of 72 percent of the sewers are smaller than 24 inches. Heights of 54 inches and larger, classified as walk-through sewers, account for an average of about 15 percent of the total combined sewer mileage. (Tucker-ASCE)
W70-01057

PRESSURE TUBING FIELD INVESTIGATION,

American Society of Civil Engineers, New York.

L. Scott Tucker.
Available from Clearinghouse as PB-186 011 at \$3.00 in paper copy or \$0.65 in microfiche. ASCE Combined Sewer Separation Project, Technical Memorandum No 5, Aug 15, 1967. 29 p, 19 fig, 2 tab, 1 ref. FWPCA Program No 11020 EKO.

Descriptors: *On-site tests, Conduits, Cost analysis, Trenches.

Identifiers: *Sewer-within-sewer, Building lateral, Copper tubing, Plastic tubing, Pressure sewers, Washington, D.C.

Three methods of installing pressure tubing from houses or small buildings, and of connecting the tubing with street pressure conduits, are described and discussed. One would be the installation and connection of pressure tubing and conduit in trenches by traditional water distribution methods. Field trials were conducted to indicate the feasibility of inserting tubing in building sewers. Tubing was pushed through an 86-foot long 4- 5-inch diameter building lateral, which included three 45 deg bends, from a specially dug pit at the upstream end into a 4-foot diameter combined sewer. The forward end of the tubing was guided by a special leader device. Three fourths-, 1-, and 1 1/2-inch polyethylene tubing could be pushed. Polybutylene and copper tubes could not be pushed because they buckled or crimped. A Kellems grip and swivel on the end of a rope were used to pull tubing from the combined sewer to the upstream pit. Three fourths-, 1-, and 1 1/4-inch polyethylene and 3/4- and 1-inch polybutylene could be pulled. Three fourths-inch copper tubing could not be pulled because of its stiffness. The third method, tested in the field, combined the insertion of tubing with a street main in trench. Cost estimates were made for the later two methods. (Tucker-ASCE)
W70-01058

NON-MECHANICAL CONSIDERATIONS INVOLVED IN IMPLEMENTING PRESSURIZED SEWERAGE SYSTEMS,

American Society of Civil Engineers, New York.

Donald H. Waller.
Available from Clearinghouse as PB-186 008 at \$3.00 in paper copy or \$0.65 in microfiche. ASCE Combined Sewer Separation Project, Technical Memorandum No 12, May 31, 1968. 27 p, 1 tab, 4 ref. FWPCA Program No 11020 EKO.

Descriptors: *Administration, *Economic justification, *Legal aspects.

Identifiers: *Interviews, Radcliff (Ky), Storage-grinder-pump.

Installation of a storage-grinder-pump unit in every home raises questions regarding: allocation of costs of the units; responsibility for malfunction of the units; arrangements for service of the units; and willingness of owners to accept the presence of units in their buildings. Twenty-five householders in Radcliff, Kentucky, whose houses are served by sewage ejector units were interviewed to obtain opinions about features of the units that appeared to represent potential sources of nuisance, inconvenience, or other liabilities. Also interviewed were the superintendent of the utility operating the Radcliff sewerage system, owners of five houses in Louisville, Kentucky, at which sewage sampling stations were located, and three consulting engineering firms who have considered schemes involving the installation of sewage pumping equipment on private properties. Opinions and practices reported reflect the view that sewage pumping equipment placed on private property as part of a public project should be purchased, installed, and serviced at public expense. (Tucker-ASCE)
W70-01065

SPECIAL REQUIREMENTS FOR A FULL SCALE FIELD DEMONSTRATION OF THE ASCE COMBINED SEWER SEPARATION PROJECT SCHEME,

American Society of Civil Engineers, New York.

Donald H. Waller.

Available from Clearinghouse as PB-186 009 at \$3.00 in paper copy or \$0.65 in microfiche. ASCE Combined Sewer Separation Project, Technical Memorandum No 13, June 3, 1968. 84 p, 12 fig, 13 tab, 10 ref. FWPCA Program No 11020 EKO.

Descriptors: *Benefits, *Costs, Anaerobic conditions, Legal aspects, Measurement, Overflow.
Identifiers: *Field demonstration planning, Flow obstructions, Interviews, Public cooperation, Sewer separation, Storage-grinder-pump.

Matters that should be considered in planning a field demonstration of the ASCE Project pressure sewer scheme are summarized. These include: importance of connecting as many buildings as possible in the demonstration project area; need for protection from overflows of building storage-grinder-pump units; relationship between occurrence of overflows from buildings and given levels of public inspection, detection and control; effectiveness of alarms on storage-grinder-pump units; legal agreements with property owners; importance of complete records of project costs; effectiveness of the project as a pollution control measure; possible benefits of elimination of infiltration from interceptors and treatment plants; detection and clearing of obstructions; use of polymer additives to reduce fluid friction; behavior of unground sewage including anaerobic decomposition; self-cleansing characteristics of flow; rate and extent of deterioration of friction factors; sewage flow variations and their relationship to water demands; handling of interruptions of service; and field tests on installations in walk-through combined sewers. The appendix is an assessment of the physical problems to be overcome in separation of plumbing on private property, with estimates of cost, based on information from officials in seven large cities having combined sewers, and from a consulting engineer and a recent American Public Works Association survey. (Tucker-ASCE)

W70-01066

ROUTING OF FLOWS IN SANITARY SEWERAGE SYSTEMS,

American Society of Civil Engineers, New York.

L. Scott Tucker.

Available from Clearinghouse as PB-186 010 at \$3.00 in paper copy or \$0.65 in microfiche. ASCE Combined Sewer Separation Project, Technical Memorandum No 14, July 18, 1969. 39 p, 15 fig, 1 tab, 8 ref. FWPCA Program No 11020 EKO.

Descriptors: *Attenuation, Hydrographs, Pressure conduits, Water demand.

Identifiers: *Flow routing, *Theoretical moments, Dwelling units, Mean Milwaukee (Wis), Nodes, Peak flow, Skewness, Variance.

Water demand data from individual homes, assumed to represent sewage flows, were combined by routing into a 10-home input unit. These input units were then routed through a hypothetical pressure sewer collection system via a hydrograph superposition procedure. The hypothetical pressure sewer system served 3,270 dwelling units. The ratio of peak flow to the two-week average flow was 2.7 at the outlet. Similar analyses of portions of the pressure system consisting of 1,000 and 250 dwelling units were made. The ratio of peak to the two-week average for the 1,000 dwelling unit portion of system was 3.5, and for the 250 dwelling unit portion of the system was 4.0. A method of analysis based on notes and calculations of Professor H. A. Thomas of Harvard U. involving theoretical moments of frequency distributions is presented. The method is explained by applying it to a simple example of a sewage collection system. The method provides an estimate of peak flows and time of occurrence, and has a potential for examining parameter sensitivity. (Tucker-ASCE)

W70-01067

A WATER DISTRIBUTION SYSTEM FOR COLD REGIONS, The Single Main Recirculating Method. An Historical Review, Field Evaluation, and Suggested Design procedures,

Alaska Univ., College. Inst. of Water Resources.

For primary bibliographic entry see Field 04A.
 W70-01088

W70-01111

THE SEISMIC DESIGN STUDY OF A DOUBLE CURVATURE ARCH DAM,

Gibb (Alexander) and Partners, London (England); Imperial Coll. of Science and Technology, London (England); and Bristol Univ. (England). P. A. A. Back, A. C. Cassell, and R. Dungar. Inst Civ Eng Proc, Vol 43, p 217-248, June, 1969. 32 p, 19 fig, 3 tab, 17 ref, 3 append.

Descriptors: *Seismic design, Seismic studies, *Arch dams, Vibrations, *Model tests, Earthquakes, Earthquake engineering, Foreign research, Stress, Digital computers, Test procedures, Analysis, Natural frequency, Electric analogs, Mathematical analysis, Computer programming, Bibliographies.
Identifiers: *Seismic tests, *Double-curvature arch dams, Earthquake loads, Great Britain, Republic of So Africa, Test results, Dynamic tests.

Use of high-speed digital computers in the application of a new technique of earthquake design to study seismic behavior of an arch dam is described. This study applies to the Hendrik Verwoerd Dam on the Orange River, Republic of South Africa. The technique (based on use of finite elements) takes full account of dynamic response of a structure to an earthquake, providing a complete history of stresses and deflections within the arch during the passage of the earthquake. To avoid an enormous printout of noncritical information, provision is made to print only the maximum envelope of principal stresses and deflections and times of occurrences. A printout can be provided of the instantaneous state of stress and deflection of the structure for any given moment which, from examination of the times of the occurrence of the maxima, is particularly significant. Scale model tests of the dam are described whereby critical frequencies of vibration, predicted by mathematical analysis, were subsequently verified by a method of multipoint vibration resonance tests. Results of tests using these new techniques are compared with the classical method of earthquake analysis, indicating dynamic stresses in certain parts of the dam were underestimated by factors of 2 or 3. (USBR)

W70-01094

DESIGN OF CALIFORNIA AQUEDUCT,
 California State Dept. of Water Resources, Sacramento.

Harald D. Frederiksen. Proc Amer Soc Civ Eng, J Irrig Drain Div, Vol 95, No IR2, p 307-328, June, 1969. 22 p, 8 fig, 3 ref, 2 append.

Descriptors: *Aqueducts, *California, Design, Design criteria, Canals, Water resources development, Pipelines, Channels, Reservoirs, Planning, Pumping plants, Operation and maintenance, Remote control, Distribution systems, Monitoring, Simulation, Irrigation, Operations, Water delivery, Water management (Applied), Computer programming.
Identifiers: *California Aqueduct, California Department of Water Res, San Joaquin Valley (Calif), Systems engineering, Emergency closures.

The design of the California Aqueduct Project by the California Department of Water Resources considered the scheme of operation as an integral component of the physical design of the system. The scheme was based on an analysis of existing water delivery projects, definition of project functions, and extensive analysis, including computer simulation. Developing a controlled volume concept of operation and design for remote control made possible greater reliability, more efficient operation, and rapid response in emergencies. The result is an aqueduct designed and constructed to reliably, efficiently, and economically deliver water to the San Joaquin Valley and Southern California. A greater degree of safety and reliability is provided than was possible by traditional design and operation methods. (USBR)

THE ASWAN HIGH DAM,
 Texas Univ., Austin.

For primary bibliographic entry see Field 06B.
 W70-01201

NEW WATER BIRD FOR EGYPT: A ROBOT SHADOOF,

Rand Corp., Santa Monica, Calif.

For primary bibliographic entry see Field 03F.
 W70-01205

8B. Hydraulics

ANALYTICAL SOLUTION FOR TURBULENT FLOW IN PIPES,

Universidad Central de Venezuela, Caracas. Dept. of Engineering.

A. Zagustin, and K. Zagustin. La Houille Blanche, No 2, p 113-118, 1969. 3 fig, 1 append.

Descriptors: *Turbulent flow, *Pipes, *Pipe flow, Velocity, Mixing, Eddies, Viscosity, Theoretical analysis, Equations, Energy equation.

Identifiers: *Circular pipe, Differential equations, Pulsation energy.

New analytical expressions are given for the velocity, mixing length and eddy viscosity for turbulent flow in a smooth circular pipe. These expressions are obtained from a set of differential equations for turbulent flow plus a 'balance of pulsation energy' equation. The present theoretical results agree better with the experimental data than those of earlier theories, and furthermore, in contrast to earlier theories, the velocity distribution curve has no singularity at the center line. (Carstea-USGS)

W70-00870

NON-LINEAR FREE SURFACES IN OPEN CHANNELS (FRENCH),

Centre National de la Recherche Scientifique, Chatillon-sous-Bagnoeux (France). Centre de Calcul Analogique.

C. Bellevaux, and D. Fruman. La Houille Blanche, No 2, p 119-122, 1969. 7 fig, 7 ref.

Descriptors: *Open channels, *Free surfaces, *Open channel flow, *Flow, *Supercritical flow, Subcritical flow, Measurement, Equilibrium, Stability.

Identifiers: Non-linear free surfaces, Sills.

A calculation method is presented for free flow surfaces with sills. Use of transformed plan enables the free surface position to be established. The nonlinear surface equilibrium condition is met by successive approximation. Two calculation schemes are presented, one for supercritical flow and the other for subcritical flow. A stability study shows only the former scheme to be stable; the subcritical scheme will not converge unless modified. The scope of the method is illustrated by examples. (Carstea-USGS)

W70-00871

PROPAGATION OF WAVE-FRONTS IN WIDE CHANNELS OF ARBITRARY CROSS-SECTION,

Leeds Univ. (England).

G. D. Crapper. La Houille Blanche, No 2, p 123-126, 1969. 6 fig, 3 ref.

Descriptors: *Waves (Water), *Channels, *Open channel flow, *Unsteady flow, Cross-sections, Hydraulics, Channel flow, Equations, Mathematical studies.

Identifiers: *Wave-front propagation, Triangular section open channels.

Field 08—ENGINEERING WORKS

Group 8B—Hydraulics

A simple method for predicting the movement of a wave-front and a measure of its strength in a system described by hyperbolic partial differential equations is adapted from published work and applied to channel hydraulics. The equations are applicable to any channel configuration including longitudinal and transversal channel variations. A solution for a channel with a triangular cross-section is discussed. The wave-front splits along the centerline and the initial disturbance moves away to the sides of the channel. (Carstea-USGS)

W70-00872

EXPERIMENTAL RESEARCH ON SPILLWAY SHAFT FLOW (FRENCH), Liege Univ. (Belgium).

A. Schlag.
La Houille Blanche, No 2, p 127-136, 1969. 23 fig, 1 tab.

Descriptors: *Closed conduit flow, *Shafts (Excavation), *Spillways, *Research and development, Discharge (Water), Pressure head, Froude number, Weirs, Pipe flow, Pipes, Mathematical studies, Orifice flow.

Identifiers: Weir flow, Pressure pipe flow.

The relationships between vertical-shaft spillway discharge, head at the shaft and diameter and length of the column are studied. The relationship between the non-dimensional factors of head/diameter, length/diameter, and Froude number is also established. Depending on the Froude number, the following cases of flow are possible: (1) weir flow giving a parabolic curve with a horizontal axis; (2) pressure pipe flow giving a parabola with a vertical axis; (3) orifice flow under certain discharge conditions and for Froude number of about 0.5. A different type of orifice flow is produced by a momentary outside influence. Formulae are presented and discussed for 3 forms of flow. (Carstea-USGS)

W70-00873

DETECTION OF CAVITATION BY ACOUSTIC AND VIBRATION-MEASUREMENT METHODS, Technical Univ. of Budapest (Hungary). Dept. of Hydraulic Machinery.

J. J. Varga, G. Sebestyen, and A. Fay.
La Houille Blanche, No 2, p 137-149, 1969. 26 fig, 24 ref.

Descriptors: *Cavitation, *Vibrations, *Acoustics, Pumps, Turbines, Tunnels, Flow, Velocity, Erosion.

Identifiers: *Cavitation detection, Noise measurement, Cavitation erosion.

The validity of acoustic methods for incipient cavitation determination is confirmed by measurements of noise from pumps and Francis turbines in a cavitation tunnel. Cavitational flow shows two noise-generating sources: (1) the noise produced by flow conditions, emitted at a discrete frequency; (2) the noise produced by the collapse of the cavitation bubbles, which covers a wide frequency band. Acceleration level measurements seem to be much more advantageous than the sound pressure level measurements. The intensity of cavitation erosion is highly correlated with the intensity of the noise. Noise intensity is proportional to the fifth power of velocity under cavitation conditions. (Carstea-USGS)

W70-00875

ANALYTICAL STUDIES OF TURBULENT FRICTION IN ANNULAR CONDUITS,

American Society of Civil Engineers, New York.
Alan R. Nelson, and James M. Robertson.

Available from Clearinghouse as PB-186 002 at \$3.00 in paper copy or \$0.65 in microfiche. ASCE Combined Sewer Separation Project, University of Illinois, T and AM Report No 321, Nov 1968. 81 p, 38 fig, 5 tab, 16 ref. FWPCA Program No 11020 EKO.

Descriptors: *Flow rates, *Pressure conduits, *Roughness, Digital computer, Head loss, Turbulent flow.

Identifiers: *Annular pipes, *Eccentricity, *Radius ratio, *Velocity distribution, Diessler and Taylor, Sewer-within-sewer.

An analytical solution for fully developed turbulent flow in an annular conduit is presented, performed with the aid of a digital computer. To account for the observed divergence of the velocity traverses of recent investigations with increasing ratio of radius of inside wall of outside pipe to radius of outside of inserted pipe, a modified wall law-core law velocity formulation is adopted. The effect of variations in radius ratio, eccentricity, and roughness upon the location of maximum velocity, velocity distribution, and friction are discussed. The radius of maximum velocity is found to be nearer the wall of the inserted pipe for smooth annuli and is independent of Reynolds number for values greater than 40,000. Friction decreases with increased eccentricity but is considerably less affected by changes in the radius ratio. Variations in wall roughness cause the greatest alteration in the flow occurrences in annular conduits. Using the modified two-law velocity distribution, a new prediction of friction is given for the limiting case of radius ratio approaching unity. Even though equivalent magnitudes were not achieved for experimental and analytical results, the trends are similar. (Tucker-ASCE)

W70-01045

TURBULENT FRICTION IN ECCENTRIC ANNULAR CONDUITS,

American Society of Civil Engineers, New York.
James M. Robertson.

Available from Clearinghouse as PB-185 993 at \$3.00 in paper copy or \$0.65 in microfiche. ASCE Combined Sewer Separation Project, Univ of Illinois, T and AM Report No 310, Mar 1968. 63 p, 13 fig, 3 tab, 48 ref. FWPCA Program No 11020 EKO.

Descriptors: *Flow around objects, *Head loss, *Pressure conduits, Data collections, Flow rates.

Identifiers: *Annular pipes, *Hangers, Eccentricity, Sewer-within-sewer.

Following a general review of the analytical and experimental information on the friction loss encountered by fluids flowing in annular pipes, with particular regard to the influence of eccentricity of the inner member, experiments are described on an evaluation of the friction of water in a steel annular pipe of diameter ratios 5.8 and 3.2 in the Reynolds number range of ten to the fifth power to ten to the sixth power. It is found that on a discharge basis, for the same head loss in a given length, with the diameter ratio of 5.8 the flow capacity of the pipe line is decreased 12.7% in the concentric situation but only 4.5% with full eccentricity. The latter decrease is not greatly different from the 3% reduction in area due to the inserted smaller pipe. An analysis is included showing that for the simple insert at full eccentricity the near-full-flow capacity of a sewer is little affected. The effects of hangers such as might be employed to support inserts in sewers is found to have an appreciable effect on the flow capacity of a full-flowing sewer. (Tucker-ASCE)

W70-01046

RELATIONSHIP OF SEWAGE CHARACTERISTICS TO CARRYING VELOCITY FOR PRESSURE SEWERS,

American Society of Civil Engineers, New York.
M. Floyd Hobbs.

Available from Clearinghouse as PB-185 991 at \$3.00 in paper copy or \$0.65 in microfiche. ASCE Combined Sewer Separation Project, FMC Corporation Report No R-2598, Aug 1967. 96 p, 10 fig, 54 tab, 2 ref. FWPCA program No 11020 EKO.

Descriptors: *Data collections, *Deposition (Seawage sediments), *Pressure conduit, *Scour.

Identifiers: *Sand concentration, *Seawage analysis, Communitor, Grinder, Santa Clara (Calif.).

Minimum carrying velocities for solid phase matter in smooth plastic 2 in., 3 in., 4 in., 6 in., and 8 in. pressure pipes were measured using comminuted and uncommminated raw sewage. The minimum velocity for scouring and the maximum velocity for depositing were essentially the same. Velocities appeared to be independent of: the concentration magnitudes of suspended solids, fixed suspended solids, sand concentration, and the size distribution of suspended matter and sand for the sewages studied. Velocities appeared to be dependent on the fixed solids content or sand which accumulated on the pipe bottom. Egg shells that had been passed through a garbage grinder were carried at lower flow rates than required for moving the bottom sediments. Carrying velocities were investigated in an 8 in. spiral pressure pipe but the results obtained were very erratic. Tests were also made on the 8 in. plain plastic pipe with open channel flow. All data acquired are reported. (Tucker-ASCE)

W70-01047

LONG-TERM OPERATION OF WASTEWATER OBSERVATION STATIONS (TASK 2),

American Society of Civil Engineers, New York.
R. Paul Farrell.

Available from Clearinghouse as PB-185 994 at \$3.00 in paper copy or \$0.65 in microfiche. ASCE Combined Sewer Separation Project, General Electric Co Report No S-68-1064, Apr 24, 1968. 48 p 12 fig, 13 tab, 5 ref. FWPCA Program No 11020 EKO.

Descriptors: *Maintenance, *Pressure conduit, Data collections, Laboratory tests.

Identifiers: *Operating experience, *Wastewater sampling stations, check valve operation, On-site observations, Plumbing fixture tests, Pump operation, Sewage flow (Household).

In the terminal phase of operation of two household wastewater observation stations, the stations were operated for seven months during which the principal objective was collection of usage experience. The two garbage grinders were never a source of difficulty. The 3/4-inch check valves regularly trapped fibrous or stringy materials. A significant increase in head loss in the 3/4-inch discharge tubing in the last month of operation at one station is attributed to a thick coating of anaerobic slime on the interior walls, attributed to low inflow rates and extended periods of disuse. The 1-inch tubing at the other station was essentially clean throughout the tests. Results of fixture flow tests, and information on overflows from the station wet-wells, was obtained to supplement results of the earlier studies. (Tucker-ASCE)

W70-01049

SAMPLING AND ANALYSIS OF WASTE WATER FROM INDIVIDUAL HOMES (TASK 2),

American Society of Civil Engineers, New York.

R. P. Farrell, J. S. Anderson, and J. L. Setser.
Available from Clearinghouse as PB-185 990 at \$3.00 in paper copy or \$0.65 in microfiche. ASCE Combined Sewer Separation Project, General Electric Co Report No 67-MAL-3, Mar 24, 1967. 79 p, 16 fig, 17 tab, 8 ref. FWPCA Program No 11020 EKO.

Descriptors: *Data collections, *Laboratory tests, *Water demand (Household), Hydrographs, Peak discharge, Telemetry.

Identifiers: *Seawage flow (Household), *Wastewater sampling stations, Domestic wastes grinder, Louisville (Ky), Plumbing fixture tests.

The results of the initial phase of operation of two household wastewater observation stations are described. During a three month period household wastewater was sampled for analysis, wastewater flow rates were measured, and the behavior of components when handling wastewater under actual conditions of use was observed. Each station included a garbage grinder for reduction of incoming sewage solids sizes, a float well and level recorder, a pump and pump operation time

recorder, a check valve on the pump discharge line, and fifty feet of clear plastic discharge tubing. An extensive program of sampling and analysis was carried out to characterize completely the wastewater from each home. Particulate matter in the wastewater was analyzed over an intensive seven-day period to determine its exact nature in terms of particle size, density and microscopic appearance. Analyses were made of water demand data obtained from measurements at one gallon intervals at each house telemetered to recording equipment. A set of fixture tests, during which fixtures were discharged singly and in combinations in preplanned sequences, was run at both stations to obtain information on water and sewage flow patterns for fixtures. (Tucker-ASCE) W70-01050

SEWAGE FLOW VARIATIONS IN INDIVIDUAL HOMES,

American Society of Civil Engineers, New York.
L. Scott Tucker.

Available from Clearinghouse as PB-185 996 at \$3.00 in paper copy or \$0.65 in microfiche. ASCE Combined Sewer Separation Project, Technical Memorandum No 2, Feb 24, 1967. 70 p, 7 fig, 25 tab, 2 ref. FWPCA Program No 11020 EKO.

Descriptors: *Water demand (Household), *Data collections, Pumping, Storage, Design, Pipe, Distribution patterns.

Identifiers: *Peak demands, *Sewage flow (Household), Flow routing.

Winter water demands are assumed to represent sewage flows in the absence of sewage flow data. Two sets of 1-minute interval household water demand data are used: from six homes in Maryland for two weeks, and from two homes in Louisville for four weeks. Maximum and minimum 24-hour and 60-, 15-, and 4-minute demands for each day are given for each home. Frequency distributions of 24-hour and 60-minute flows for each sample are compared with each other and with distributions of total flows from groups of 3 houses and 6 houses. Based on routing of peak flows from nearly five hundred home-days of data through various storage-pump combinations, a pump capacity of 10 GPM and a usable storage capacity of 30 gal. are indicated for initial sizing of household storage-grinder-pump units. Pressure discharge tubing to handle expected flows at reasonable head losses would be 3/4 to 1 1/4 inch I.D. (Tucker-ASCE) W70-01055

MINIMUM TRANSPORT VELOCITY FOR PRESSURIZED SANITARY SEWERS,

American Society of Civil Engineers, New York.
Murray B. McPherson, L. Scott Tucker, and M.

Floyd Hobbs.

Available from Clearinghouse as PB-186 013 at \$3.00 in paper copy or \$0.65 in microfiche. ASCE Combined Sewer Separation Project, Technical Memorandum No 7, Nov 16, 1967. 23 p, 4 fig, 2 tab, 8 ref. FWPCA Program No 11020 EKO.

Descriptors: *Deposition (Sewage sediments), *Pressure conduits, *Scour, Data collections, Design criteria, Regression analysis.

Identifiers: *Sand concentration, *Sewage analysis, *Transport velocity, Communion, Grinding, Sanitary sewage.

Raw sewage, with and without particle-size reduction by comminution, was pumped through 2-in. to 8-in. clear plastic pipe. Extensive observation indicated rather conclusively that the material last to be scoured and first to be deposited was predominantly sand. For all tests, the sewage was salted with ground egg shells but these were always moved at lower mean flow velocities than the sand, which was in low concentrations, viz., 8 to 78 ppm. No discernable difference was noted in the minimum transport velocities for comminuted and uncomminuted sewage, and the difference between minimum scouring velocities and maximum depositing velocities was small. Test results were

blended with those from sand transport experiments elsewhere for general representation. Exploratory open channel tests were made with the 8-in. pipe for a firmer correlation with sand tests. Results are presented in terms of dimensionless parameters. Limited tests were made on 8-in. spiral corrugated pipe. (Tucker-ASCE) W70-01060

DOMESTIC SEWAGE FLOW CRITERIA FOR EVALUATION OF PROJECT SCHEME TO ACTUAL COMBINED SEWER DRAINAGE AREAS,

American Society of Civil Engineers, New York.
Murray B. McPherson.

Available from Clearinghouse as PB-186 014 at \$3.00 in paper copy or \$0.65 in microfiche. ASCE Combined Sewer Separation Project, Technical Memorandum No 8, Nov 17, 1967. 19 p, 2 fig, 3 tab, 9 ref. FWPCA Program No 11020 EKO.

Descriptors: *Design criteria, *Water demand (Residential), Data collections.

Identifiers: *Domestic water use, *Peak demands, Demand variations, Sewage flow.

Residential sewage flow criteria are developed for use in design of pressurized sanitary sewers for hypothetical applications of the ASCE Project scheme. In a typical combined sewer area, data on domestic water demands is the most that can be expected to be available. On the basis of a study of winter water demand data it is concluded that projection of such observed demands for a service area to the end of the design period is the preferred basis of design. Data for California and the northeastern United States are presented separately. For each region, design curves represent the variation, as a function of the number of dwelling units served, of flows for the minimum 24 hours, for the peak hour of the minimum day, and for the maximum peak hour of any day, expressed as ratios to the annual average rate. (Tucker-ASCE) W70-01061

PEAK FLOWS OF SEWAGE FROM INDIVIDUAL HOUSES,

American Society of Civil Engineers, New York.
Donald H. Waller.

Available from Clearinghouse as PB-186 015 at \$3.00 in paper copy or \$0.65 in microfiche. ASCE Combined Sewer Separation Project, Technical Memorandum No 9, Jan 1, 1968. 117 p, 45 fig, 23 tab, 15 ref. FWPCA Program No 11020 EKO.

Descriptors: *Peak discharge, *Water demand (Household), Data collections, Plumbing.

Identifiers: *Plumbing fixture tests, *Sewage flow (Household), *Synthesized peak discharges, Louisville (Ky), Sampling stations.

Sewage flows and water demands measured at two household observation stations, as well as water and wastewater flows from individual fixtures and appliances is used to estimate upper limits of pump and storage capacities for a storage-grinder-pump unit for individual homes and to examine the relationship between peak rates of sewage flow and corresponding water demand rates. For individual fixtures, combinations of rate, duration and frequency of discharge that will produce maximum hydraulic loading conditions are selected. Single-fixture hydrographs are combined to produce synthetic hydrographs of peak period sewage discharge, from which combinations of storage and pump capacities are derived. Peak sewage flows and simultaneous water demands for a fourteen day period at one house are presented and analysed. (Tucker-ASCE) W70-01062

AN EXAMINATION OF THE BENEFITS AND DISADVANTAGES WITH RESPECT TO THE DISPOSAL OF SOLID WASTES,

American Society of Civil Engineers, New York.
For primary bibliographic entry see Field 05D.

W70-01063

CONVERGENT STILLING BASINS,

Liverpool Univ. (England).

R. B. Whittington, and K. H. M. Ali.

Inst Civ Eng Proc, Vol 43, p 157-173, June, 1969. 17 p, 18 fig, 2 tab, 8 ref.

Descriptors: *Stilling basins, Energy dissipation, Hydraulics, Foreign design practices, Supercritical flow, *Drowned (Submerged), Hydraulic jump, Froude number, Submergence, Spillways, Water surface profiles, Foreign research, Shock waves, Hydraulic models, Energy losses.

Identifiers: *Convergence, *Converging flow, Sweepout, Submerged flow, Great Britain.

Operation of convergent stilling basins in the drowned jump condition is discussed. Particular attention is paid to the occurrence of sweepout. When a basin is fully swept out, the flow in the basin remains supercritical, and the basin is then ineffective as an energy dissipator. A momentum equation is given for calculating the backing-up depth at the entrance to the basin; this yields good agreement with experimental results. The observed phenomena are compared to Ippen's fundamental work on oblique shock waves. Special reference is made to the stilling basin for the Llys-Y-Fran Dam under construction in Great Britain. (USBR) W70-01099

HYDRAULIC PROPERTIES OF SMALL UNLINED ROCK TUNNELS,

Helsinki City Waterworks (Finland).

Seppo Priha.

Proc Amer Soc Civ Eng, J Hydraul Div, Vol 95, No HY4, p 1181-1209, July 1969. 29 p, 27 fig, 9 tab, 10 ref, 2 append.

Descriptors: *Water tunnels (Conveyance), *Tunnel hydraulics, Foreign design practices, *Tunnels, *Roughness (Hydraulic), Cross sections, Model tests, Reynolds number, Pressure tunnels, Hydraulic models, *Hydraulic properties.

Identifiers: *Unlined tunnels, Finland, *Friction coefficient (Hyd).

Factors influencing hydraulic characteristics of small unlined tunnel cross sections are presented. Investigations were performed in rock tunnels constructed by the Helsinki City Waterworks for conveying raw water. The length of the Silvolä Reservoir entrance tunnel is 1.8 km; the theoretical cross section is 4.5 sq m. The length of the Silvolä-Vanhakaupunki raw water tunnel is 7.6 km; the theoretical cross section is 6 sq m. Vertical shafts divided both tunnels into 3 parts, in all of which cross-sectional measurements and pressure loss measurements for different discharges were accomplished using measuring weirs and Siemens Venturi meters. All 3 tunnels were excavated by the so-called Swedish method in the most usual type of rock in Finland, composed mostly of granite and gneiss. (USBR) W70-01115

ON THE CONCEPT OF MEAN HYDRAULIC RADIUS,

West Virginia Univ., Morgantown.

Desmond F. Moore.

Proc Amer Soc Civ Eng, J Hydraul Div, Vol 95, No HY4, p 1305-1319, July 1969. 15 p, 6 fig, 3 tab, 8 ref, 4 append.

Descriptors: *Hydraulic radius, Hydraulics, Open channels, Fluid flow, Open channel flow, Roughness coefficient, Roughness (Hydraulic), Viscous flow, Instrumentation, Laminar flow, Forecasting.

Identifiers: Aspect ratio, Rugosity, *Hydraulic diameter.

The flow rate through any channel may be predicted by using the hydrodynamic analogy between the torsion of a uniform bar with arbitrary cross section and viscous flow through a channel of the same shape. Parameters required are: (1) computation of the aspect ratio of the cross section of the channel; (2) measurement of the area using a

Field 08—ENGINEERING WORKS

Group 8B—Hydraulics

planimeter; (3) measurement of the wetted perimeter of flow; and (4) observation of the number of significant sides composing the cross section. The mean hydraulic radius may be obtained as the quotient of (2) and (3). The parameter is then modified by (1) and (4) to improve the accuracy of the prediction. The same concepts may be used for channels having variable shapes and sizes along their lengths. In such cases, an equivalent area is defined in the computation of hydraulic radius according to a method outlined in the appendix. Experimental support for the concepts proposed has been furnished from extensive tests using plates with regular and random asperities. The validity of the mean hydraulic radius concept has led to the development of a scientific outflow instrument capable of predicting the drainage ability of road surfaces subjected to pneumatic tire traffic. (USBR)
W70-01117

HEAD LOSSES CAUSED BY AN ICE COVER ON OPEN CHANNELS,

Worcester Polytechnic Inst., Mass.

Peter A. Larsen.
J Boston Soc Civ Eng, Vol 56, No 1, p 45-67, Jan 1969. 23 p, 20 fig, 4 ref.

Descriptors: *Head loss, *Energy losses, *Open channels, *Open channel flow, *Ice, Hydraulics, *Roughness coefficient, Hydraulic design, Water surface profiles, Roughness (Hydraulic), Canals, Mannings equation, Foreign research.
Identifiers: *Ice cover, Sweden.

A rational formula for composite roughness, based on the concept of logarithmic velocity distribution, was developed; field data relative to the roughness of the ice cover on 2 Swedish power channels are reported. The undersurface of ice on a channel had irregularities formed by the flowing water. The effect of these irregularities corresponds to a certain roughness expressible in terms of an equivalent roughness height. The mechanics of the formation are not known, and predicting the roughness of the ice cover on a channel of given hydraulic characteristics and climatic conditions is not possible. The formula derived for composite roughness is based on the assumption of 2 parallel (or slightly converging) boundaries, an assumption merely limiting the applicability to the case considered in this paper. The approach to this problem may be applicable in an attempt to develop a more general solution to the problem of composite roughness. The need for such a solution is obvious for design purposes and laboratory use; gathering field data on the ice cover roughness phenomenon should continue. (USBR)
W70-01126

NEW PROBLEMS IN THE THEORY OF BOTTOM CURRENTS IN RESERVOIRS,

Politekhnicheskii Institut, Leningrad (USSR).

I. I. Levi.

Transl from Russ, Bur Reclam Transl 784, Aug 1969. 19 p, 4 fig, 2 tab. Izv Vses Inst Gidrotekh, No 78, p 71-82, 1965.

Descriptors: Hydraulics, *Density currents, *Reservoirs, Mathematical analysis, Reservoir operation, Reynolds number, Laminar flow, Turbidity, Open channel flow, Velocity, Suspended sediments, Roughness (Hydraulic), Boundary layers, *Velocity distribution, Experimental data, Stratified flow, Foreign research, Depth, Currents (Water).
Identifiers: USSR, Reverse flow, Current patterns.

Bottom currents usually form in mountain reservoirs when the depth is greater than 30 to 40 m with suspended sediments of more than 3 to 4 kg/cu m. Unit discharges and depth of water can reach large magnitudes. Under these conditions, the assumption of disregarding movement in the upper zone of the reservoir cannot always be considered valid. The problem of velocity distribution in reservoirs during formation of bottom currents is examined. Differential equations are given for

determining the movement of the bottom flow. Values are established for the normal and critical depths of bottom flow, surface velocities, reverse flows, and the line of zero velocities. Equations are derived for a reservoir with a horizontal bottom. The analysis broadens concepts of steady, nonuniform motion of fluids of different densities in reservoirs, making possible a mathematical determination of velocity distribution curves and line of zero velocity in reservoirs. (USBR)
W70-01129

CHARACTERISTIC PRESSURE DISTRIBUTION IN OUTLET WORKS INLETS,

Army Engineer Waterways Experiment Station, Vicksburg, Miss.

Robert G. Cox, and Yen H. Chu.
Miscellaneous Paper H-69-8, Sept 1969. 12 p, 24 fig, 17 ref.

Descriptors: *Outlet works, *Intakes, *Pressures, Hydraulic models, Flow.

Report summarizes a study of inlet pressures measured in nine hydraulic models and two laboratory investigations of entrance designs for flood control outlet works. The experimental data are examined to determine the effects of upstream face geometry, guide piers, and bulkhead and gate slots. Both two-dimensional and three-dimensional flow inlets are considered and compared with free-streamline inlets. The results are presented graphically in terms of dimensionless pressure drop coefficients for use in estimating pressure conditions to be expected in design practice. Design criteria are recommended. (Spivey - Waterways Experiment Station)
W70-01222

SPILLWAY FOR REND LAKE RESERVOIR, BIG MUDDY RIVER, ILLINOIS; HYDRAULIC MODEL INVESTIGATION,

Army Engineer Waterways Experiment Station, Vicksburg, Miss.

Bobby P. Fletcher, and John L. Grace.
Sponsored by US Army Engineer District, St. Louis. Technical Report H-69-7, May 1969. 15 p, 1 tab, 7 photo, 11 pl.

Descriptors: *Spillways, *Hydraulic models, Stilling basins, Riprap, Flow, Channels, Laboratory tests.

Identifiers: *Rend Lake Reservoir, Big Muddy River.

Test of spillway were conducted with a 1:16-scale model that reproduced a 129-ft length of the 435-ft-long main spillway to study adequacy of spillway, stilling basin, and exit channel protective stone. After completion of tests concerned with the notched portion of spillway, the notch was filled in and the model revised to permit study of flow conditions at right abutment. Approximately 250 ft of approach channel and 500 ft of exit channel were reproduced. Particular emphasis was placed upon selection of a stilling basin downstream of the notched section. Flow conditions in the approach, at the right abutment, and over the main spillway were satisfactory. Capacity of the spillway as determined by the model was approximately the same as computed. Performance of the original stilling basin was unsatisfactory in dissipation of all spillway discharges due primarily to high unit discharge through the notched section. Four alternate designs were investigated and a stilling basin was developed which proved satisfactory. Model tests indicated that riprap proposed in the approach for the original design was adequate. (Spivey - Waterways Experiment Station)
W70-01223

8C. Hydraulic Machinery

ADVANCED DEVELOPMENT OF HOUSEHOLD PUMP-STORAGE-GRINDER UNIT (TASK 6),

American Society of Civil Engineers, New York.

R. Paul Farrell.

Available from Clearinghouse as PB-186 004 at \$3.00 in paper copy or \$0.65 in microfiche. ASCE Combined Sewer Separation Project, General Electric Co Report No S-69-1038, Dec 1968. 74 p 22 fig, 7 tab, 10 ref. FWPCA Program No 11020 EKO.

Descriptors: *Capital costs, *Design, *Installation costs, *Operating costs, Performance, Pump.

Identifiers: *Check valve, *Development, *Grinding, Storage-grinder-pump.

This report describes the development, by the General Electric Company for the ASCE Project, of a 150-pound household storage-grinder-pump unit comprising a domestic sewage grinder and progressing-cavity pump driven by a 1-h.p., 1725-r.p.m. motor, and mounted on a 58-gallon receiver tank, meeting criteria established by the Project investigation. The unit is capable of discharging through a backflow valve and 1 1/4-in. outlet at 15-gpm at atmospheric pressure and 11-gpm at 35 psig pressure. The estimated cost of the unit without tank is \$343, and estimated total installed costs are \$548 for new work and \$648 where cutting and patching are involved. Cost of energy for operation is about \$2 per year. (Tucker-ASCE)
W70-01048

EXPERIENCE WITH GRINDING AND PUMPING OF SEWAGE FROM BUILDINGS,

American Society of Civil Engineers, New York.

Donald H. Waller.

Available from Clearinghouse as two reports as PB-185 997 and PB-185 998 at \$3.00 in paper copy or \$0.65 in microfiche per report. ASCE Combined Sewer Separation Project, Technical Memoranda Nos 3 May 1, 1967, and 3A, Mar 1, 1968. 102 p and 47 p respectively. FWPCA Program No 11020 EKO.

Descriptors: *Maintenance, *Operations, *Pumping, Pipes, Valves, Water reuse.

Identifiers: *Comminutors, *Garbage grinders, Liljendahl, Vacuum system.

In TM No. 3, a typical garbage grinder is described and use of grinders for toilet wastes is reviewed. Two wet process building-waste pulping systems and two machines that combine the functions of grinding and pumping are described. Practice in the use of pumps, piping and backflow valves for sewage in buildings is reviewed. An appendix describes the Liljendahl vacuum sewerage system. Results of monitoring the operation of thirty-six comminutor installations that serve individual buildings are reported in TM No. 3A. The monitoring program, which covered periods of up to sixteen months, is described. Descriptions and prior operating histories of the installations are included. Frequency of attention and maintenance is recorded and compared with manufacturers' recommendations. Twenty-five of the machines were inspected at least five times each week. Twenty-four of the installations include sewage pumps following the comminutors with discharge mains 3 to 6 inches in diameter. An appendix contains a summary description of a system developed at Pennsylvania State University for conservation of water in residences by recycling. (Tucker-ASCE)
W70-01056

HYDRAULICS OF A PRESSURIZED SEWERAGE SYSTEM AND USE OF CENTRIFUGAL PUMPS,

American Society of Civil Engineers, New York.

L. Scott Tucker.

Available from Clearinghouse as PB-186 012 at \$3.00 in paper copy or \$0.65 in microfiche. ASCE Combined Sewer Separation Project, Technical Memorandum No 6, Nov 15, 1967. 35 p, 14 fig, 1 tab, 12 ref. FWPCA Program No 11020 EKO.

Descriptors: *Pumps (Centrifugal), Flow characteristics, Hydraulics.

Identifiers: *Pump characteristics, Control valves, Pressure sewers, Total dynamic head.

Hydraulic gradients for high and low sewage flows and the use of pressure control devices for service zones and interceptors applicable to pressure sewer systems are illustrated and discussed. For some flat drainage areas sewage pumping, in addition to pumping provided by pumps located in buildings, would be necessary; a pressure control assembly would be needed immediately upstream and a surge control valve would be used immediately downstream of a lift station. For steep drainage areas, pressure control assemblies would be needed to limit maximum pressures. Centrifugal pump characteristics are discussed and information on thirty-two classes of sewage and solids handling pumps is tabulated. Characteristics for centrifugal pumps capable of pumping sewage are such that maximum reasonable limits on discharge rates would be greatly exceeded if variations in total dynamic head were allowed to equal curb pressure variations that are expected in some parts of a pressure sewer system. Ordinary use of centrifugal pumps in these cases would be precluded. A possible modification of building pumping systems with a valve controlled to maintain a constant discharge pressure is discussed, together with the use of variable speed drivers. (Tucker-ASCE)

W70-01059

CONTROL TECHNIQUES FOR PRESSURIZED SEWERAGE SYSTEMS,

American Society of Civil Engineers, New York.

James R. Daneker, and William H. Frazel.

Available from Clearinghouse as PB-186 007 at \$3.00 in paper copy or \$0.65 in microfiche. ASCE Combined Sewer Separation Project, Technical Memorandum No 11, Mar 4, 1968. 27 p, 11 fig. FWPCA Program No 11010 EKO.

Descriptors: *Butterfly valves, Pressure conduits, Venturi meters.

Identifiers: *Control systems, *Flow control, *Pressure control, Electronic systems, Fail safe designs, Hydro-electric systems, Hydro-pneumatic systems, Magnetic flow meter, Pneumatic systems, Transducers.

Instrumentation and control of a pressurized sewer system can be attained with current technology, and special designs are foreseen that can approach zero maintenance. A rubber-seated butterfly valve is recommended for the basic control element. For 'system No. 1' a fixed pressure is maintained upstream of the control valve by modulation of the valve to correct or reduce any deviation of measured pressure from a selected set point. A pressure sensing element would be directly connected to the control valve. For 'system No. 2' the control valve would be modulated to maintain a specific upstream pressure corresponding to every rate of flow measured at a flow sensing element. A venturi type or magnetic meter could be used for measurement of flow, and a transducer (with a changeable can that could be cut in the field) would be required to generate some characterized signal that would actuate the control valve. 'System No. 3' would apply to a booster or lift station and the start-stop sequence of a centrifugal pump would be controlled to permit starting without surge and to maintain a constant discharge pressure. For a booster station the pump speed would be varied in response to suction pressure. For nearly fool-proof fail-safe control, all-hydraulic control systems are recommended in preference to pneumatic, hydro-pneumatic, or electronic systems. (Tucker-ASCE)

W70-01064

PHOTOGRAMMETRIC MEASUREMENT OF ROCK SURFACES IN A POWER TUNNEL,

Imperial Coll. of Science and Technology, London (England); Binnie and Partners, London (England); and Fairey Surveys Ltd. (Gr. Brit.).

For primary bibliographic entry see Field 07B.

W70-01090

ELECTRICAL DESIGN OF PARAMETERS USED FOR EHV SYSTEMS,

Westinghouse Electric Corp., Pittsburgh, Pa.

C. L. Wagner.

Transn Distrib, Vol 21, No 6, p 63-69, June, 1969. 7 p, 6 fig, 2 tab, 9 ref.

Descriptors: *Extra high voltage, *Transmission lines, Conductors, *Electrical design, Systems analysis, Lightning arresters, Economics, Electrical coronas, Radio interference, Electric insulation, Costs, Electrical insulators, Electrical equipment, Transmission (Electrical).

Identifiers: *Ultra high voltage, Switching surges, Short circuits, Transient stability, Lightning surges, Withstand level (Electric).

Electrical design of ehv systems can be separated into 4 parts: system analysis, conductor specification, line insulation, and equipment insulation. Although based on 500-kv system studies, the methods discussed apply to all ehv and uhv systems, and might be used for systems of 230 kv and below. Examples used are results of 500-kv design studies. Various factors concerning transmission system analysis are discussed. Conductor selection for ehv is dependent upon several interrelated variables considered from the overall operating and economic aspect. Line insulation requirements depend upon normal and transient conditions. Transmission lines designed for satisfactory lightning and switching surge performance are adequate for 60-hz conditions. The correct insulation level for equipment is an important application problem in ehv. A general method for determining correct insulation and results therefrom are summarized. (USBR)

W70-01093

UPLIFT RESISTANCE OF ANCHOR BAR, AUGER AND PRESSED PLATE FOOTINGS IN SANDY SILT,

Bureau of Reclamation, Denver, Colo.

James M. Horner.

Bur Reclam Rep No EM-768, May, 1969. 60 p, 43 fig, 5 tab, 1 ref, append.

Descriptors: Field tests, *Footings, Transmission towers, Silts, Loads (Forces), Movement, Soil properties, Soil mechanics, Soil tests, Lateral forces, Geometry, Arizona, Ponding, Soil strength, Shear strength, Soil moisture, Sands, *Anchored towers.

Identifiers: Mead-Liberty Transmission Line, *Uplift resistance, Pullout tests, Bellied footings, *Anchored footings, Auger-type footings.

Four types of transmission tower footings were tested under uplift loads to determine load-movement performance. The performance of the anchor bar footing in sandy silt was of special interest. The straight auger, bellied auger, and pressed plate footings were tested to provide a comparison with the anchor bar footing results. Each footing was tested in natural and ponded soils conditions. For the anchor bar footing at vertical failure movement (1/2 in.), the load resisted was over 110 kips in natural soil and about 115 kips in ponded soil. For the other 3 types of footings, loads at vertical failure movement were: 55 to 105 kips for straight auger, 80 to 100 kips for bellied auger, and 17.5 to 25.0 kips for pressed plate. Design loads were 28.7 kips for concrete footings and from 14.1 to 18.0 kips for pressed plate footings. Soil samples were analyzed in the laboratory. A method of predicting failure loads for the anchor bar footings using the soil test results was attempted, but no consistent results were obtained. (USBR)

W70-01096

FIELD TEST RESULTS ON 113,000 KW FRANCIS PUMP-TURBINES FOR NAGANO POWER STATION,

Electric Power Development Co. (Japan); and Hitachi Ltd., Hitachi City (Japan).

Katsuhiro Suzuki, and Kakehiko Yamamoto.

Hitachi Rev, Vol 18, No 6, p 228-234, May, 1969. 7 p, 14 fig, 1 tab, 5 ref.

Descriptors: *Pump turbines, *Field tests, *Performance tests, Test procedures, Model tests, Prototype tests, Noise, Reduction, Water hammer,

Vibrations, Characteristics, Calculations, Electronic equipment, Computers, *Francis turbines, Hydraulic turbines.

Identifiers: *Test results, Japan foreign testing, Load rejection, *Reversible turbines.

Results of field tests conducted on the 113,000-kw, 111-m-head, reversible pump turbines for Nagano Powerplant, Japan, are discussed. These units are the largest of their kind in Japan and went into commercial operation in July 1968. Before manufacturing the equipment, various site operation tests were conducted; results were considered carefully with those of various model tests performed prior to manufacture of the prototype pump turbines to determine operational performance of the units. Principal data gained are discharge-versus-power characteristics, starting characteristics, transient phenomena at load and input rejection, and vibration information. Partial-load noise in the turbine was studied. Improvement in runner cone design was the most effective method of noise reduction. Changeover time from one mode of operation to the other was measured. (USBR)

W70-01097

IMPROVED DIGITAL SIMULATION FOR ANALYZING POWER SYSTEM DISTURBANCES,

Westinghouse Electric Corp., Pittsburgh, Pa.

C. J. Baldwin, and R. T. Byerly.

Westinghouse Eng, Vol 29, No 4, p 109-116, July 1969. 8 p, 8 fig.

Descriptors: *Electrical studies, *Digital computers, *Power system operations, *Electrical stability, *Simulation, *Computers, Direct current, Computer programming, Transmission lines, Alternating current, Analysis, Excitation, Electric Power production, Governors, Hydroelectric power, Thermal power, Electric relays, Voltage regulators, Disturbances.

Identifiers: *Power system stability, *Interconnected systems, Load shedding, Synchronous machines, System stability (Elect).

A digital computer program incorporating recent advances in power systems analysis techniques provides a powerful tool for studying system stability following a fault or loss of generation, transmission, or load. Stability can be evaluated effectively by this new program, accommodating as many as 2000 buses, 3000 lines, and 600 generating units. Systems having 100 generating plants have been studied by this method. The increased size and detail of the new system simulation program is made possible by the availability of new large-memory digital computers. This new approach to systems analysis is discussed and sample output tabulations for simulations made with the computer program are given. Interconnection planning studies in the western United States have given momentum to much of the program development in recent years. (USBR)

W70-01105

INCREASING THE CAVITATION RESISTANCE OF PARTS BY USING EXPLOSIVE-WELDED FACINGS,

A. S. Gel'man, N. I. Pylaev, and B. D.

Tsemakhovich.

Transl from Russ, Bur Reclam Transl 462, Aug 1969. 9 p, 1 fig, 3 ref. Energomashinostr, No 12, p 34-35, 1967.

Descriptors: *Manufacturing, *Cavitation, *Hydraulic turbines, Turbine parts, Turbine blades, Laboratory tests, Testing machines, Adhesion, Test procedures, Foreign research, *Welding, Stainless steel, Materials testing, Metals treatment, *Metal coatings, Heat treatment.

Identifiers: USSR, *Explosive welding, *Cavitation control, *Cladding, *Cavitation resistance, Metal bonding, Low carbon steel.

Facing metal parts by explosive welding of stainless steel strips to low-carbon steel base of machinery

Field 08—ENGINEERING WORKS

Group 8C—Hydraulic Machinery

parts has been developed and tested by several USSR institutes. Because of the degree to which the Francis and Kaplan turbine water passages are subject to cavitation, recent testing was conducted to study the effect of explosive welding cladding of blades on cavitation resistance. In explosive welding, the charge is deposited uniformly on the facing surface some distance from the part being clad. The explosion moves the facing at great speed toward the part. A pressure of 100,000 atm causes a jet to be thrown out of the contact zone, carrying with it acids and waste products. High pressure and plastic shear cause the metal to turn to a semiliquid state, forming a strong bond. Advantages are: removing the need for heating welded parts, welding metal difficult to weld normally, and attaining high static and fatigue strength of faced parts. Cavitation resistance of specimens faced with the stainless steels tested by explosive welding is not inferior to the initial resistance of these steels. Explosive welding produces a strong welded bond meeting conditions of repeated and variable microimpacts. (USBR)

W70-01127

WATER-POWER DEVELOPMENT, CONSERVATION OF HYDROELECTRIC POWER DAMS AND WORKS.

For primary bibliographic entry see Field 06E.
W70-01175

RIGHT OF EMINENT DOMAIN OF PUBLIC SERVICE CORPORATIONS.

For primary bibliographic entry see Field 06E.
W70-01176

8D. Soil Mechanics

CERTAIN ASPECTS OF ENGINEERING GEOLOGY IN PERMAFROST,

Army Terrestrial Sciences Center, Hanover, N.H.

G. K. Swinzw.

Eng Geol, Vol 3, No 3, p 177-215, July 1969. 39 p, 12 fig, 3 tab, 51 ref.

Descriptors: *Permafrost, *Engineering geology, *Frozen ground, *Rheology, Mining engineering, Tunnels, Frost heaving, Soil mechanics, Ice, Freezing, Thawing, Soil types, Foundation investigations. Identifiers: Permafrost engineering.

The principal topics of engineering geology in permafrost are reviewed. Permafrost is defined and soil mechanical properties, rheology, patterned ground, ice wedges, pingoes, and icings are described. Although the strength of frozen soil is much greater than that of unfrozen soil, frozen soil creep and movement of thawed permafrost are severe engineering problems to be solved. Tunneling and mining problems, highway construction, road building, and airfield building and operation are briefly described. (Knapp-USGS)
W70-01011

DETERMINING PORE PRESSURE IN SLIGHTLY PERMEABLE SOILS IN THE BODY OF A DAM DURING THE PROCESS OF THEIR CONSOLIDATION,

A. A. Nichiporovich, and T. I. Tsibul'nik.

Translated from Trudy VIDGEO, No 4, p 5-37, 1963. Bur Reclam Transl 561, July 1969. 40 p, 23 fig, 5 tab, 18 ref.

Descriptors: *Pore pressure, *Earth dams, Cores, Consolidation, Creep, Soil moisture, Experimental data, Investigations, Calculations, Moisture content, Filtration, Plasticity index, Foreign research, Soils, Stress, Yield point, Soil mechanics, Saturation, Groundwater, Bibliographies, Soil density, Mathematical analysis.

Identifiers: USSR, Hydrodynamic pressures, Dynamic loads, Nurek Dam, USSR, Finite difference method.

When erecting comparatively high dams from local materials, the profile of which contains a core made from soil having a low filtration coefficient, excess pore pressure builds up in these soils during consolidation. During periods of construction and operation of the dam, the resistance to creep depends on the magnitude of the pore pressure; the greater the pore pressure, the lower the resistance of the tenacious soils to slip. An especially high pore pressure can occur either in soils under the effect of high stresses occurring in high dams or with comparatively low stresses but in insufficiently dense and waterlogged soil. The existing theoretical and experimental methods of determining pore pressure are analyzed and experiments for determining the pore pressure are described. Validity for using this index as a function of soil density and moisture in designing earth dams is confirmed, but different methods should be used on various types and dimensions of earth dams. The distinctive features of each method are given. Pore pressure diagrams are presented from determinations made under laboratory conditions; data are compared with those for the Nurek Dam, USSR. (USBR)

W70-01091

ADVANTAGES AND LIMITATIONS OF THE OBSERVATIONAL METHOD IN APPLIED SOIL MECHANICS,

Illinois Univ., Urbana.

R. B. Peck.

Geotech, Vol 19, No 2, p 171-187, June, 1969. 17 p, 7 fig, 8 ref.

Descriptors: *Soil mechanics, Construction, Foundations, Design, Earth dams, Dam design, Foundation investigations, Design criteria, Subsurface investigations, Foundation failure, Optimum design, Pore pressure, Soil stabilization, Subsidence, Settlement (Structural), Change orders, Structural stability, Engineering geology.

Identifiers: Terzaghi, *Observational method, Rankine lectures, Cost savings, Problem solving, Progressive failures.

The observational method, used so successfully by Terzaghi in applied soil mechanics, often permits maximum economy and assurance of safety, provided the design can be modified as construction progresses. Essential features of the method are set forth and examples of the application are given. The method is not without pitfalls and limitations. It should not be used unless the designer has a plan of action in mind for every unfavorable situation that might be disclosed by the observations. The observations must be reliable, reveal the significant phenomena, and be so reported as to encourage prompt action. The possibility of progressive failure may introduce a serious element of uncertainty. The essential ingredient is the visualization of all possible eventualities and the preparation in advance of courses of action to meet whatever situation develops. In spite of the limitations of the observational method, the potential for saving time and money without sacrificing safety is so great that engineers dealing with applied soil mechanics should be informed of the principal features of the method. (USBR)

W70-01092

A SEMI-EMPIRICAL METHOD FOR DETERMINING STRESSES BENEATH EMBANKMENTS,

Middle East Technical Univ., Ankara (Turkey).

T. Mirata.

Geotech, Vol 19, No 2, p 188-204, June, 1969. 17 p, 8 fig, 15 ref.

Descriptors: Soil engineering, Soil mechanics, Earth dams, Foreign design practices, Earth materials, Earth movements, *Embankments, *Foundations, *Stress analysis, Calculations, Displacements, *Stress, *Deformation, Bibliographies, Shear stress, Settlement (Structural), Shear.

Identifiers: Embankment subsidence, Turkey, Horizontal displacements, Vertical displacements.

Available methods for complete solution of stresses and displacements within and beneath embankments are either experimental or numerical, involving recourse to a digital computer with all the necessary ancillary work. Calculating settlements and lateral deformations using a slide rule and a few tables and charts results in making oversimplifying assumptions that may lead to unnecessarily high errors. A semi-empirical method is presented to bridge the gap between intricate computations and intolerable inaccuracy in determining deformations beneath embankments. The method requires no specialized training and yields reasonably accurate results. Attention is concentrated on foundation stresses, but the procedure can be used for estimating vertical and horizontal stresses within the embankment. The method is applicable to embankments on semi-infinite foundations and those resting on an elastic layer. (USBR)

W70-01102

CONTROLLING THE EXPANSION OF DESICCATED CLAYS DURING CONSTRUCTION,

Bureau of Reclamation, Denver, Colo.

J. P. Bara.

Pap, Second Int Res Eng Conf Expansive Clay Soils, Texas A and M Univ, College Station, Aug 1969. 27 p, 10 fig, 14 ref.

Descriptors: *Expansive clays, Canals, *Canal construction, Shrinkage, Canal design, *Canal embankments, *Foundation investigations, Moisture content, Central Valley Project, Soil moisture, Soil stabilization, Soil tests, Liquid limits, Canal linings, Sprinkling, Compaction, California, Construction, Cracks, Ponding, Ponding tests, Soil mechanics, Control.

Identifiers: *San Luis Unit (Calif), Desiccation, *Controlled expansion.

Expansive clays have been creating foundation problems in construction for centuries. Canal performance records show that continuous concrete linings can be virtually destroyed by expanding clay foundations unless precautions are taken. Control measures developed for identifying and reducing the expansive potential of foundation clays are described. These methods are being used by the Bureau of Reclamation in constructing the San Luis Drain, San Luis Unit, Central Valley Project, Calif. Three schemes for stabilizing expansive clays are discussed. Foundation soils for the San Luis Drain were investigated; foundation moisture control criteria were developed; test sections were established to evaluate construction methods; control requirements for embankments built of fat clay were established; and construction procedures for controlling expansion of clay foundations and embankments were developed. (USBR)

W70-01112

DECKED ROCKFILL DAMS,

Hydro-Electric Commission, Tasmania.

J. K. Wilkins.

Inst Eng, Aust Civ Eng Trans, Vol CE 10, No 1, p 119-129, Apr 1968. 11 p, 17 fig, 2 tab, 10 ref, 3 append, disc.

Descriptors: *Rockfill dams, *Impervious membranes, Cutoffs, Reviews, Dam foundations, Impervious blankets, Dam design, Shear strength, Dams, Asphaltic concrete, Density, Settlement, Compaction, Foreign design practices, Strain, Stress, Deformation, Calculations, *Membranes, Reinforced concrete, Small structures.

Identifiers: *Dam facings, Australia, *Facings.

The concept of building a dam by making a bank of gravel or rock and covering the upstream face with a waterproof membrane or deck is simple. Successful small dams of this type have been built in many parts of the world. No design of a mathematical nature is necessary if (1) the foundation is hard (compacted gravel or rock), (2) the fill material is strong, (3) an adequate cutoff to impervious material is constructed, (4) the membrane is reasonably watertight, (5) the dam is low

(preferably below 50 ft high), and (6) the slopes are no steeper than 37 deg to the horizontal. Existing design and construction practices are reviewed and troubles arising from decked rockfill dams discussed. A method of computing strains and stresses in the decking material caused by movements of the fill was developed. Comparisons are made between computed strains and strains recorded at Salt Springs Dam in the U.S. Recommendations are given for reducing cost and improving the performance of concrete-faced and asphaltic-concrete-faced dams. (USBR) W70-01121

MULTISENSOR ANALYSIS FOR SOILS MAPPING,
Bureau of Public Roads, Washington, D.C.; and
Purdue Univ., Lafayette, Ind.
For primary bibliographic entry see Field 07B.
W70-01125

8E. Rock Mechanics and Geology

GEOLOGY, PETROLEUM DEVELOPMENT, AND SEISMICITY OF THE SANTA BARBARA CHANNEL REGION, CALIFORNIA,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 05B.
W70-00836

THE RELATIONSHIP BETWEEN THE ULTIMATE RESISTIVITY OF CLAYEY SANDSTONES AND THEIR POROSITY AND CLAY CONTENTS (RUSSIAN),
Vsesoyuznyi Nauchno-Issledovatel'skii Institut Geofizicheskikh Metodov Razvedki, Moscow (USSR).
For primary bibliographic entry see Field 07B.
W70-00876

ESTIMATION OF CLAY CONTENT OF SAND FORMATIONS FROM WELL-LOGGING DATA (RUSSIAN),
Vsesoyuznyi Nauchno-Issledovatel'skii Institut Geofizicheskikh Metodov Razvedki, Moscow (USSR).
For primary bibliographic entry see Field 07B.
W70-00877

THE SEISMIC DESIGN STUDY OF A DOUBLE CURVATURE ARCH DAM,
Gibb (Alexander) and Partners, London (England); Imperial Coll. of Science and Technology, London (England); and Bristol Univ. (England).
For primary bibliographic entry see Field 08A.
W70-01094

STRENGTH OF DISCONTINUOUS ROCKS IN DIRECT SHEAR,
New Brunswick Univ., Fredericton.
E. Z. Lajtai.
Geotech, Vol 19, No 2, p 218-233, June, 1969. 18 p, 18 fig, 7 ref.

Descriptors: *Shear strength, Shear stress, Shear tests, Shear planes, *Shear failures, Rock mechanics, Tensile strength, *Direct shear, Joints (Geology), Fractures (Geology), Friction, Internal friction, Strength of materials, Failure (Mechanics), *Discontinuities, *Rocks.
Identifiers: Weakness planes, Foreign testing, Canada, Rock tests, Ultimate strength.

The strength of discontinuous rocks under direct shear loading is examined analytically and experimentally. In the direct shear test, a homogeneous and isotropic block of rock may fail by 3 mechanisms: failure in tension, failure in shear, and failure at ultimate strength. Strength parameters include tensile strength, fundamental shear strength (cohesion), angle of internal friction at ultimate

strength, and the normal stress on plane of enforced shear. The direct shear strength of planes of weakness, oriented in the plane of enforced shear, is derived from the strength of solid rock and joint friction along the separated parts of the shear surface. Maximum shear strength develops only if soil strength and joint friction are mobilized simultaneously at the same deformation. (USBR) W70-01101

A LABORATORY INVESTIGATION OF BOREHOLE STABILITY, Shell Development Co., Modesto, Calif.

H. C. H. Darley.
J Petrol Technol, p 883-892, July 1969. 10 p, 9 fig, 4 tab, 6 ref.

Descriptors: *Shales, *Boreholes, *Drill holes, Rock properties, Drilling, Drilling fluids, *Expansion, *Deformation, Swelling, Stability, Montmorillonite, Laboratory tests, Collapse, Failure (Mechanics), Permeability, Failures, Earth pressure.

Identifiers: Spalling, Unstable ground.

The principal causes of unstable boreholes and the classes of troublesome shales have been known for many years, but there still are difficulties in identifying the cause of hole problems and consequently in selecting the right technique for combating them. A laboratory study was undertaken on the basic mechanisms causing borehole instability in shales. The chemistry and physics of shales are reviewed, tests are developed for characterizing shales, and a model was constructed to study borehole stability. Reconstituted shale specimens were subjected to triaxial stresses and various fluids were circulated through an axially drilled hole in the specimen. The experimental program established 3 particular failure mechanisms: changes in borehole diameter caused by swelling, hole enlargement in brittle shales, and instability caused by high earth stresses. (USBR) W70-01107

HYDRAULIC DESIGN OF UNLINED ROCK TUNNELS,

Army Engineer Waterways Experiment Station, Vicksburg, Miss.

Carl J. Huval.
Proc Amer Soc Civ Eng, J Hydraul Div, Vol 95, No HY4, p 1235-1246, July 1969. 12 p, 5 fig, 2 tab, 24 ref, 2 append.

Descriptors: Hydraulics, *Tunnel hydraulics, *Tunnels, *Hydraulic design, Overbreak, *Tunnel design, Flow resistance, Mannings equation, Roughness coefficient, Hydraulic structures, Overexcavation, Linings correlation techniques, Diversion tunnels, Hydroelectric power, Water tunnels (Conveyance), Water tunnels (Testing), Bibliographies, Rocks.
Identifiers: *Unlined tunnels, Rock traps.

Many unlined rock tunnels have been built for flood flow diversion and for hydropower tunnels where the rock is of sound quality and not greatly jointed and fractured. The number of unlined rock tunnels will increase in the years ahead because new methods of drilling, blasting, and muck removal have been developed and improved to make tunnel construction more economical. Methods of tunnel stabilization, such as grouting and use of rock bolts, have been improved so that many kinds of rock and difficult driving conditions can be handled more flexibly. Savings of unlined rock tunnels in time and cost of construction have been demonstrated by the ready acceptance of this type of tunnel in Sweden, Norway, Australia, and the United States. Unlined rock tunnel resistance coefficients can be predicted by using a rock overbreak parameter. The important considerations entering into design of unlined rock tunnels are summarized. The present method of predicting hydraulic resistance is inadequate. A study of tunnel rock overbreak experience leads to a relation between rock overbreak and tunnel size. This measure of

rock overbreak provides a simple correlation of flow resistance test results based on the fully rough flow equation. (USBR) W70-01114

RELATION BETWEEN THE STATIC AND THE DYNAMIC DEFORMATION INDEXES OF ROCK IN LARGE-SCALE TESTS ON ROCK MASSES,

S. B. Ukhov, and A. S. Panenkov.
Hydrotech Constr, No 11, p 996-1001, Nov 1968. 6 p, 5 fig, 13 ref.

Descriptors: *Rock foundations, *Rock mechanics, Dam foundations, Test procedures, Foundation investigations, Field tests, Static tests, Rocks, Field investigations, *Deformation, *Elasticity modulus, Experimental data, Correlation techniques, Fissures (Geology), Engineering geology, Rock properties, Sandstones, Schists.

Identifiers: *Deformation modulus, Rock tests, USSR, Foreign testing, *Plate load tests, Ultrasonic tests, Dynamic tests, In situ tests.

A correlation between dynamic modulus of elasticity and the static moduli of total deformation was established on large-scale tests of rock foundations. Static and dynamic tests were made in adits in the foundation rock of Andizhansk and Kirovsk Dams in the USSR. Static moduli of deformation were determined by applying loads of 40 kg/sq cm through concrete plates. Dynamic moduli were determined by ultrasonic instruments operating at frequencies of 25 to 100 kc/sec. The instruments were placed in boreholes drilled along the perimeter of the concrete loading plate. Tests were made on 5 types of rock: massive sandstone, laminated sandstone, and 3 types of schist. An analysis of experimental techniques and principles of test data interpretation was made in evaluating the relation between static and dynamic deformation indexes. The application of indirect and direct correlation techniques is discussed. Results obtained by direct correlation of experimental data show good agreement. The proposed correlation may be used in investigating deformation indexes of fissured rock masses under standardized static testing conditions. (USBR) W70-01124

8F. Concrete

CRACKS IN BLOCKS OF THE BRATSK HYDROELECTRIC STATION DAM,

S. Ia. Eidel'man, and L. P. Trapeznikov.
Transl from Russ, Bur Reclam Transl 691, July 1969. 20 fig, 2 tab, 22 ref. Izv Vses Nauch-Issled Inst Gidrotekh, Vol 79, p 41-70, 1965.

Descriptors: *Cracks, *Concrete dams, Creep, Strain gages, Expansion, Stress, Tensile stress, Plastic deformation, Deformation, Heating, Test procedures, Temperature, Foreign research, Safety factors, Construction joints, Compression, Tensile strength, Instrumentation, Bibliographies, Concrete technology, Foreign projects.

Identifiers: *Crack control, USSR, Crack propagation, Foreign testing, *Bratsk Dam (USSR), Test results, Cold climates.

Preventing temperature cracks in mass concrete has always been a problem in dam construction. Intensive cracking of early dams stimulated theoretical and experimental studies, and engineering measures were devised for maintaining the monolithic nature of concrete dams. These measures, including concrete temperature control and breaking the structure by joints, have reduced temperature cracking. Results of field observations on temperature cracking in the massive concrete dam at Bratsk, USSR, and the factors causing these cracks are analyzed. Many remote-controlled strain gages embedded in the blocks of the dam for studying internal stress conditions were either in or near the cracks. This permitted determining the moment of cracking, the stress condition prior to this process,

Field 08—ENGINEERING WORKS

Group 8F—Concrete

and the dynamics of crack development. Of particular interest are the data on internal cracks, unobtainable through ordinary visual observations.
(USBR)
W70-01119

8G. Materials

ON THE POSSIBILITY OF ESTIMATING THE THICKNESS OF UNCONSOLIDATED ROCKS BY VERTICAL ELECTRICAL SOUNDING IN PERMAFROST AREAS (RUSSIAN),
Vsesoyuznyi Nauchno-Issledovatelskii Institut Geofizicheskikh Metodov Razedki, Moscow (USSR).

For primary bibliographic entry see Field 07B.
W70-00878

tron beam having a power density of 1 million w/sq cm in the focal spot. The electron beam penetrates rock 0.01 cm deep. The kinetic energy of the electrons is dissipated almost instantly, giving an energy propagation much faster than could ever be accomplished by heat conduction. The rock surface layer melts in 15 micro-sec. The melt-front would propagate at a rate of 6.6 m/sec if the molten target material could be removed quickly. The molten material normally is unable to flow away fast enough, and is further heated by the electron beam and vaporized. Vapor pressure and vaporization rate increase exponentially with temperature, permitting rapid removal of material. Thermal effects can significantly augment melt cutting, producing sufficient stress to completely fragment the rock. Melt cutting and rock breaking tests in the laboratory are discussed. The energy efficiency of the electron beam method is very high, competitive with conventional methods, and far superior to some of the newer experimental methods. Equipment and maintenance costs are expected to be low. (USBR)
W70-01109

8H. Rapid Excavation

ELECTRON BEAMS APPLY AN OLD PRINCIPLE TO MODERN ROCK-BREAKING,
Westinghouse Electric Corp., Pittsburgh, Pa.
B. W. Schumacher.
Eng Mining J, Vol 170, No 6, p 116-119, June, 1969. 4 p, 7 fig, 1 tab.

Descriptors: *Rock excavation, Rocks, Rock mechanics, *Electron beams, Engineering geology, *Cutting, Drilling, Drilling equipment, Electrons, Concretes, Melting, Tunneling, Penetration, Vaporization, Construction, Quarrying.
Identifiers: *Rock breakage, Rock tests, Cutters, *Electron (Beam cutting), Underground openings.

An electron-beam cutter offers the prospects of reduced costs and increased speed in tunneling and other hard-rock excavation operations. The present electron gun has a power of 10 kw, operates at 150 kv, and produces a focused elec-

Nat Air Pollut Contr Admin Publication No AP-59, Oct 1969. 48 p, 7 fig, 6 tab, 127 ref.

Descriptors: *Climates, *Climatic data, *Cities, *Publications, Surveys, Climatic zones, Precipitation (Atmospheric), Humidity, Temperature, Radiation, Winds, Air pollution, Water vapor, Meteorological data.

Identifiers: *Urban climatology, *Urban-rural climates, Literature survey, Metropolitan studies.

City climate differs from the surrounding rural areas; increasing scientific research devoted to comparative studies of urban and rural climates point up this difference. This report reviews the literature on city climatology, particularly that written since a series of papers published by Dr. H. Landsberg (1956 to 1962). The Landsberg papers serve as a standard and provide the basis for this report on city-rural meteorological differences. Meteorological aspects discussed in the report include temperature, humidity, precipitation, radiation, wind, and visibility. (Lang-USGS)
W70-00988

10. SCIENTIFIC AND TECHNICAL INFORMATION

ANNOTATED BIBLIOGRAPHY ON HYDROLOGY AND SEDIMENTATION, 1963-65, UNITED STATES AND CANADA.
Engineering-Science, Inc., Los Altos, Calif.
For primary bibliographic entry see Field 02J.
W70-00837

THE CLIMATE OF CITIES: A SURVEY OF RECENT LITERATURE,
National Air Pollution Control Administration, Raleigh, N.C.
James T. Peterson.

WATER QUALITY CRITERIA FOR EUROPEAN FRESHWATER FISH; LIST OF LITERATURE ON THE EFFECT OF WATER TEMPERATURE ON FISH.

Food and Agriculture Organization of the United Nations, Rome (Italy). European Inland Fisheries Advisory Commission.
For primary bibliographic entry see Field 05C.
W70-01227

WATER QUALITY CRITERIA FOR EUROPEAN FRESHWATER FISH; REPORT ON WATER TEMPERATURE AND INLAND FISHERIES BASED MAINLY ON SLAVONIC LITERATURE.
Food and Agriculture Organization of the United Nations, Rome (Italy). European Inland Fisheries Advisory Commission.
For primary bibliographic entry see Field 05C.
W70-01228

SUBJECT INDEX

ACCELERATED EROSION		
SOIL SLIPPAGE AN INDICATOR OF SLOPE INSTABILITY ON CHAPARRAL WATERSHEDS OF SOUTHERN CALIFORNIA,		
W70-01196	02J	
ACCESS ROUTES		
THE DILEMMA OF WATER RECREATION AND A SUGGESTED SOLUTION (PART I),		
W70-00931	06D	
ACCRETION(LEGAL ASPECTS)		
COMMENT EXTENDING THE APPLICATION OF THE LAW OF ACCRETIONS.		
W70-00921	04A	
ACID MINE WATER		
STATUTORY STREAM POLLUTION CONTROL,		
W70-00925	05G	
ACOUSTICS		
DETECTION OF CAVITATION BY ACOUSTIC AND VIBRATION-MEASUREMENT METHODS,		
W70-00875	08B	
ACTIVATED SLUDGE		
OPTIMIZATION OF THE ACTIVATED SLUDGE PROCESS-OPTIMUM VOLUME RATIO OF AERATION AND SEDIMENTATION VESSELS,		
W70-00893	05D	
ACUTE TOXICITY MEASUREMENT		
A RAPID FOR MEASURING THE ACUTE TOXICITY OF DISSOLVED MATERIALS TO MARINE FISHES,		
W70-00849	05A	
ADMINISTRATION		
NON-MECHANICAL CONSIDERATIONS INVOLVED IN IMPLEMENTING PRESSURIZED SEWERAGE SYSTEMS,		
W70-01065	08A	
ADMINISTRATIVE AGENCIES		
STATE HIGHWAYS.		
W70-00888	04A	
DAMS.		
W70-00891	04A	
REAL PROPERTY--RIPARIAN GRANTS--LEGISLATIVE LIMITATIONS ON EXTENT OF GRANT.		
W70-00927	06B	
GOVERNMENTAL TECHNIQUES FOR THE CONSERVATION AND UTILIZATION OF WATER RESOURCES AN ANALYSIS AND PROPOSAL.		
W70-00935	06B	
DRAINAGE-SELECTION, QUALIFICATIONS, POWERS, AND DUTIES OF COMMISSIONERS AND OTHER OFFICERS.		
W70-00941	04A	
SWAMP LAND DISTRICTS.		
W70-00953	04A	
BIG BLACK RIVER BASIN DISTRICT.		
W70-00961	04A	
W70-00962	04A	
W70-00963	04A	
INSPECTION DISTRICTS POLICE FLEET.		
W70-00974	06E	
FISH AND FISHING GENERALLY MARKING OF BOATS, NETS, AND OTHER DEVICES.		
W70-00977	06E	
LICENSING OF STATIONARY AND FLOATING DUCK BLINDS.		
W70-00981	06E	
BASIC WATER USE DOCTRINES AND STATE WATER CONTROL AGENCIES.		
W70-01131	04A	
WISCONSIN LAW OF WATERS.		
W70-01138	04A	
RIPARIAN WATER RIGHTS V A PRIOR APPROPRIATION SYSTEM A COMPARISON,		
W70-01142	06B	
JURISDICTION OF COUNTY DRAINAGE BOARDS.		
W70-01150	04A	
PEARL RIVER BASIN DEVELOPMENT DISTRICT ACT.		
W70-01157	06B	
W70-01158	06B	
PEARL RIVER BASIN DEVELOPMENT ACT.		
W70-01159	06B	
FISHING, HUNTING, TRAPPING PERMITS.		
W70-01160	06E	
MARINE RESOURCES COMMISSION.		
W70-01162	03E	
SURVEYS OF AND RIGHTS IN OYSTER GROUNDS.		
W70-01163	03E	
CULLING OYSTERS.		
W70-01166	03E	
DUTIES OF DIRECTOR OF PUBLIC WORKS.		
W70-01182	04A	
OBSTRUCTIONS TO NAVIGATION.		
W70-01184	04A	
RHODE ISLAND PILOTAGE REGULATION.		
W70-01186	04A	
RHODE ISLAND WATER RESOURCES BOARD.		
W70-01187	06D	
W70-01188	06D	
W70-01190	06D	
ADMIRALTY		
RHODE ISLAND PILOTAGE REGULATION.		
W70-01186	04A	
ADSORPTION		
EFFECT OF POLYELECTROLYTES IN CONJUNCTION WITH BENTONITIC CLAY ON CONTAMINANTS REMOVAL FROM SECONDARY EFFLUENTS.		
W70-00845	05D	
DISTINGUISHING MARINE AND FRESHWATER MUDS.		
W70-00994	02K	
AEOLIAN SOILS		
THE DYNAMICS OF QUATERNARY SLOPE EVOLUTION AND ITS GEOMORPHOLOGICAL REPRESENTATION.		
W70-01041	02J	
AERATION		
OPTIMIZATION OF THE ACTIVATED SLUDGE PROCESS-OPTIMUM VOLUME RATIO OF AERATION AND SEDIMENTATION VESSELS,		
W70-00893	05D	
OXYGEN MANAGEMENT AND ARTIFICIAL REAERATION IN THE AREA OF BALDENAY LAKE AND THE LOWER RUHR RIVER (IN GERMAN).		
W70-01224	05G	
AERIAL PHOTOGRAPHY		
EARTH RESOURCE SATELLITES.		
W70-01098	07B	
SURFACE AND SUBSURFACE EXPLORATION BY INFRARED SURVEYS.		
W70-01128	07B	
AGRICULTURAL DEVELOPMENT		
THE DEVELOPMENT OF THE IRRIGATION ECONOMY OF MENDOZA, ARGENTINA,		
W70-01213	03F	
AGRICULTURE		
THE ECONOMICS OF ARIZONA'S WATER PROBLEM,		
W70-01200	06D	
PATTERNS OF WATER USE IN THE ARIZONA ECONOMY,		
W70-01202	06D	
THE DEVELOPMENT OF THE IRRIGATION ECONOMY OF MENDOZA, ARGENTINA,		
W70-01213	03F	
AIR POLLUTION		
WATER POLLUTION CONTROL AND ABATEMENT (BOOK REVIEW)		
CONTROLLING POLLUTION THE ECONOMICS OF A CLEANER AMERICA (BOOK REVIEW),		
W70-00933	05G	
POLLUTION--CAUSES, COSTS, CONTROLS.		
W70-01100	06B	
THE ENVIRONMENT--AND WHAT TO DO ABOUT IT,		
W70-01106	04D	
CITY AIR - BETTER OR WORSE,		
W70-01239	05B	
SOME OBSERVATIONS OF CLOUD INITIATION IN INDUSTRIAL AREAS,		
W70-01240	05C	
AIR POLLUTION CONTROL		
POLLUTION--CAUSES, COSTS, CONTROLS.		
W70-01100	06B	
AIR TEMPERATURE		
SOME THERMAL CHARACTERISTICS OF TWO RIVERS IN THE PENNINE AREA OF NORTHERN ENGLAND,		
W70-00881	05B	
ADAPTATION OF AIR TEMPERATURE FIELD TO WATER TEMPERATURE FIELD (RUSSIAN),		
W70-01017	02A	
NOCTURNAL AIR TEMPERATURE ON A FORESTED MOUNTAIN SLOPE,		
W70-01219	02B	
THE THERMAL CLIMATE OF CITIES,		
W70-01241	05B	
ALASKAN GROUNDWATER QUALITY		

ALA-ARI

SUBJECT INDEX

A GROUNDWATER QUALITY SUMMARY FOR ALASKA, W70-01087	04B	NATURAL FEATURES CAUSED BY A CATASTROPHIC STORM IN NELSON AND AMHERST COOUNTIES, VIRGINIA., W70-00992	02E
ALBEDO TOTAL ALBEDO OF GREAT LAKES ICE, W70-00851	02C	APPROPRIATION CONSTITUTIONAL LAW--COMMERCE CLAUSE--WATER RIGHTS IN THE FLOW OF A NON-NAVIGABLE STREAM ARE PROPERTY RIGHTS, W70-00922	04A
ALGAE THE INFLUENCE OF ALGAL ANTIBIOSIS ON THE ECOLOGY OF MARINE MICROORGANISMS, W70-01068	05C	APPROPRIATION WATER LAW ELEMENTS IN RIPARIAN DOCTRINE STATES, W70-01134	06E
A COMPOSITE RATING OF ALGAE TOLERATING ORGANIC POLLUTION, W70-01233	05C	AQUATIC ALGAE A COMPOSITE RATING OF ALGAE TOLERATING ORGANIC POLLUTION W70-01233	05C
ALGAL POISONING RECOVERY OF A SALT MARSH IN PEMBROKESHIRE, SOUTH-WEST WALES, FROM POLLUTION BY CRUDE OIL, W70-01231	05C	AQUATIC ENVIRONMENT A COMPOSITE RATING OF ALGAE TOLERATING ORGANIC POLLUTION, W70-01233	05C
ALGAL SUBSTANCES STUDIES ON ALGAL SUBSTANCES IN THE SEA. II. THE FORMATION OF GELBSTOFF (HUMIC MATERIAL) BY EXUDATES OF PHAEOPHYTA, W70-01072	05B	AQUATIC WEEDS TAKING OF SEAWEED BY INHABITANTS OF BARRINGTON. W70-00985	06E
STUDIES ON ALGAL SUBSTANCES IN THE SEA. III. THE PRODUCTION OF EXTRACELLULAR ORGANIC MATTER BY LITTORAL MARINE ALGAE, W70-01073	05B	AQUEDUCTS AQUEDUCT ROUTE OPTIMIZATION BY DYNAMIC PROGRAMMING, W70-00894	04A
STUDIES ON ALGAL SUBSTANCES IN THE SEA. I. GELBSTOFF (HUMIC MATERIAL) IN TERRESTRIAL AND MARINE WATERS, W70-01074	05B	DESIGN OF CALIFORNIA AQUEDUCT, W70-01111	08A
ALTERNATIVE IRRIGATION METHODS A PHYSICAL AND ECONOMIC ANALYSIS OF ALTERNATIVE IRRIGATION METHODS IN A SUB-HUMID CLIMATE, W70-01086	03F	AQUIFERS DETERMINING AQUIFER CHARACTERISTICS BY THE TIDAL METHOD W70-00859	02F
ALUMINUM FORMATION OF HYDROXY-AL AND -FE INTERLAYERS IN MONTMORILLONITE AND VERMICULITE INFLUENCE OF PARTICLE SIZE AND TEMPERATURE, W70-01014	02K	A SCHEME OF GEOTHERMAL WATERS OF CENTRAL ASIA (RUSSIAN), W70-00869	02F
AMMONIA THE DIURETIC RESPONSE BY RAINBOW TROUT TO SUB-LETHAL CONCENTRATIONS OF AMMONIA, W70-00848	05C	A CONJUNCTIVE OPERATION OF A SURFACE RESERVOIR AND A GROUNDWATER AQUIFER, W70-00906	02A
ANALYTICAL TECHNIQUES ESTIMATES OF PERiphyton MASS AND STREAM BOTTOM AREA USING PHOSPHOROUS-32, W70-00846	02I	THE WATER-TABLE AQUIFER IN THE EASTERN COASTAL AREA OF BELGIUM, W70-00986	02F
APPLICATION OF PYROLYTIC GAS CHROMATOGRAPHY TO NATURAL WATERS, W70-00847	05A	ARA VALLEY(JAPAN) COMPREHENSIVE WATER RESOURCES STUDIES ON THE ARA VALLEY AREA, JAPAN, W70-01034	05G
A RAPID FOR MEASURING THE ACUTE TOXICITY OF DISSOLVED MATERIALS TO MARINE FISHES, W70-00849	05A	ARCH DAMS THE SEISMIC DESIGN STUDY OF A DOUBLE CURVATURE ARCH DAM, W70-01094	08A
MODIFIED RUBEY'S LAW ACCURATELY PREDICTS SEDIMENT SETTLING VELOCITIES, W70-00855	02J	ARCTIC WATER DISTRIBUTION SYSTEM A WATER DISTRIBUTION SYSTEM FOR COLD REGIONS, THE SINGLE MAIN RECIRCULATING METHOD. AN HISTORICAL REVIEW, FIELD EVALUATION, AND SUGGESTED DESIGN PROCEDURES, W70-01088	04A
USE OF MEMBRANE FILTERS IN GRAVIMETRIC ANALYSES OF PARTICULATE MATTER IN NATURAL WATERS, W70-00857	07B	ARGENTINA THE DEVELOPMENT OF THE IRRIGATION ECONOMY OF MENDOZA, ARGENTINA, W70-01213	03F
TIME VARIANT GROUND WATER FLOW BY RESISTANCE NETWORK ANALOGUES, W70-01039	02F	ARID CLIMATES NEW WATER BIRD FOR EGYPT. A ROBOT SHADOOF, W70-01205	03F
STOCHASTIC METHODS FOR ANALYZING RIVER BASIN SYSTEMS, W70-01085	06A	ARID LANDS NET RADIATION IN A RIPARIAN MESQUITE COMMUNITY, W70-00853	02I
ANCHORED FOOTINGS UPLIFT RESISTANCE OF ANCHOR BAR, AUGER AND PRESSED PLATE FOOTINGS IN SANDY SILT, W70-01096	08C	SEASONAL CHARACTERISTICS OF TWO SALINE LAKES IN WASHINGTON, W70-01076	02H
ANEMOMETERS A STUDY OF HOT WIRE AND HOT FILM ANEMOMETERS IN WATER (FRENCH), W70-00868	07B	SOME LIMNOLOGICAL FEATURES OF A SHALLOW SALINE MEROMICTIC LAKE, W70-01077	02H
ANISOTROPY STEADY FLOW OF WATER THROUGH A TWO-LAYER SOIL, W70-00840	02G	WEATHER PATTERNS IN SOUTHERN WEST PAKISTAN, W70-01197	02B
ANNUAL COSTS COMBINED SEWER SEPARATION PROJECT, REPORT ON MILWAUKEE STUDY AREA. W70-01052	08A	THE LAND AND WATER USE SURVEY OF NORTH-CENTRAL KORDOFAN (1961-66), W70-01198	03B
ANNUAL PIPES ANALYTICAL STUDIES OF TURBULENT FRICTION IN ANNUAL CONDUTTS, W70-01045	08B	THE CHANGING ROLE OF WATER IN ARID LANDS, W70-01199	06B
TURBULENT FRICTION IN ECCENTRIC ANNUAL CONDUITS, W70-01046	08B	THE ASWAN HIGH DAM, W70-01201	06B
ANTIBIOSIS THE INFLUENCE OF ALGAL ANTIBIOSIS ON THE ECOLOGY OF MARINE MICROORGANISMS, W70-01068	05C	WATER SUPPLIES IN SOUTH AUSTRALIA, W70-01204	03B
APPALACHIAN MOUNTAIN REGION		ESTIMATION OF GRAZING CAPACITY ON ARID GRAZING LANDS, W70-01206	03F
		COMMUNITY IRRIGATION PROJECTS IN THE WAIKERIE DISTRICT OF SOUTH AUSTRALIA, W70-01207	03F
		REGIONAL AND SEASONAL WATER SUPPLY IN THE TARIM BASIN AND ITS RELATION TO CULTIVATED LAND POTENTIALS, W70-01210	03F
		SHEETFLOODES, STREAMFLOODES, AND THE FORMATION OF PEDIMENTS, W70-01211	02J

	SUBJECT INDEX	ARI-BRI
THE DEVELOPMENT OF THE IRRIGATION ECONOMY OF MENDOZA, ARGENTINA, W70-01213	03F	
THE WATER PROBLEM IN THE DESERTS OF THE USSR, W70-01215	03B	
THE STUDY OF LOCAL WATERS IN THE DESERTS OF THE USSR, W70-01216	03B	
ARIZONA LIMNOLOGICAL EFFECTS OF ORGANIC EXTRACTS OF LITTER IN A SOUTHWESTERN IMPOUNDMENT, W70-01080	02H	
THE ECONOMICS OF ARIZONA'S WATER PROBLEM, W70-01200	06D	
PATTERNS OF WATER USE IN THE ARIZONA ECONOMY, W70-01202	06D	
ARKANSAS FERRIES. W70-00913	04A	
WATER-DRAINAGE AND LEVEE DISTRICTS. W70-00942	04A	
ARTESIAN WELLS ON THE HYDROGEOLGY OF THE CENTRAL AND NORTHWESTERN PART OF THE DNEPER-DONETS ARTESIAN BASIN (UKRAINIAN), W70-00866	02K	
ARTIFICIAL WATERCOURSES NAVIGABLE WATERS--ARTIFICIAL LAKE CONNECTED TO RIVER, W70-00937	04A	
ASWAN DAM THE ASWAN HIGH DAM, W70-01201	06B	
ATMOSPHERE STATISTICAL STRUCTURE OF VERTICAL HUMIDITY PROFILES (RUSSIAN), W70-01016	02B	
ATMOSPHERIC POLLUTION POLLUTION--CAUSES, COSTS, CONTROLS. W70-01100	06B	
ATMOSPHERIC RESEARCH OPTIMIZATION TECHNIQUES IN WEATHER MODIFICATION, W70-01122	03B	
ATTENUATION ROUTING OF FLOWS IN SANITARY SEWERAGE SYSTEMS, W70-01067	08A	
AUSTRALIA WATER SUPPLIES IN SOUTH AUSTRALIA, W70-01204	03B	
ESTIMATION OF GRAZING CAPACITY ON ARID GRAZING LANDS, W70-01206	03P	
COMMUNITY IRRIGATION PROJECTS IN THE WAIKERIE DISTRICT OF SOUTH AUSTRALIA, W70-01207	03F	
AUTOCLAVING EFFECTS PERSISTENCE OF DIAZINON AND ZINOPHOS IN SOIL EFFECTS OF AUTOCLAVING, TEMPERATURE, MOISTURE, AND ACIDITY, W70-01079	02K	
AVOIDANCE REACTIONS AVOIDANCE REACTIONS OF SALMONID FISH TO REPRESENTATIVE POLLUTANTS, W70-01032	05C	
AVULSION BRYANT V PEPPE (ESTOPPEL TO ASSERT TITLE WHEN LAND CHANGED BY AVULSION). W70-00972	06E	
BAHADAS SHEETFLOODS, STREAMFLOODS, AND THE FORMATION OF PEDIMENTS, W70-01211	02J	
BALANCE OF NATURE THE ENVIRONMENT--AND WHAT TO DO ABOUT IT. W70-01106	04D	
BANKS CIVIL LAW PROPERTY--ENCROACHMENTS ON RIVER BANKS BY RIPARIAN OWNERS, W70-01135	04C	
BASE FLOW SUBSURFACE FLOW REGIMES OF A HYDROLOGIC WATERSHED MODEL, W70-01237	02F	
BEACHES TAKING OF SEAWEED BY INHABITANTS OF BARRINGTON, W70-00985	06E	
BED LOAD RELATIVE DENSITY EFFECTS ON INCIPIENT BED MOVEMENT, W70-00865	02J	
BEDS		
OWNERSHIP OF BEDS. W70-01168	06E	
BELGIUM THE WATER-TABLE AQUIFER IN THE EASTERN COASTAL AREA OF BELGIUM, W70-00986	02F	
BENEFITS SPECIAL REQUIREMENTS FOR A FULL SCALE FIELD DEMONSTRATION OF THE ASCE COMBINED SEWER SEPARATION PROJECT SCHEME, W70-01066	08A	
BERLIN ON THE PRESENT OPTIMUM VARIANT IN HYDROGEOLOGICAL EXPLORATION (GERMAN), W70-01022	07C	
BIBLIOGRAPHIES ANNOTATED BIBLIOGRAPHY ON HYDROLOGY AND SEDIMENTATION, 1963- 65, UNITED STATES AND CANADA. W70-00837	02J	
WATER QUALITY CRITERIA FOR EUROPEAN FRESHWATER FISH LIST OF LITERATURE ON THE EFFECT OF WATER TEMPERATURE ON FISH. W70-01227	05C	
BIOASSAY CHRONIC TOXICITY OF ZINC TO THE FATHEAD MINNOW, PIMEPHALES PRONELAS RAFINESQUE, W70-01229	05C	
BIOCHEMICAL OXYGEN DEMAND PHYSICAL AND BIOCHEMICAL ASPECTS OF BOD KINETICS, W70-01024	05C	
BIOCHEMICAL REACTION KINETICS PHYSICAL AND BIOCHEMICAL ASPECTS OF BOD KINETICS, W70-01024	05C	
BIODEGRADATION PHYSICAL AND BIOCHEMICAL ASPECTS OF BOD KINETICS, W70-01024	05C	
BIOINDICATORS THE CLASSIFICATION OF WATER QUALITY FROM THE BIOLOGICAL POINT OF VIEW, W70-01029	05A	
BACTERIAL AND PROTOZOAN INDICATORS OF WATER POLLUTION - STATISTICAL AND EXPERIMENTAL APPROACH, W70-01036	05A	
BIOLOGICAL TREATMENT THE USE OF THE FUNDAMENTAL STUDIES OF BIOLOGICAL PURIFICATION ON THE PURIFICATION OF POLLUTED WATERS DERIVED FROM PRODUCTION OF "KHEMLON" (SLOVAKIAN), W70-00879	05D	
BIMASS ESTIMATES OF PERIPHYTON MASS AND STREAM BOTTOM AREA USING PHOSPHOROUS-32, W70-00846	02I	
BIRDS OIL POLLUTION OF THE SEA IS THE END IN SIGHT, W70-01230	05C	
BLUE GREEN ALGAE A COMPOSITE RATING OF ALGAE TOLERATING ORGANIC POLLUTION, W70-01233	05C	
BOREHOLES A LABORATORY INVESTIGATION OF BOREHOLE STABILITY, W70-01107	08E	
BOUNDARIES(PROPERTY) BRIDGES - BOUNDARY AND OTHER WATERS. W70-00951	06E	
BRATSK DAM(USSR) CBACKS IN BLOCKS OF THE BRATSK HYDROELECTRIC STATION DAM, W70-01119	08F	
BRIDGE CONSTRUCTION BRIDGES - BOUNDARY AND OTHER WATERS. W70-00951	06E	
CONSTRUCTION, OPERATION, AND MAINTENANCE OF TOLL BRIDGES OVER PEARL RIVER. W70-01152	06E	
NJ TURNPIKE AUTHORITY V SISSELMAN (CONDAMNATION OF RIPARIAN LAND). W70-01155	06E	
BRIDGE FAILURE HIGHWAYS, FERRIES, WATERWAYS. W70-00948	06E	
BRIDGES STATE HIGHWAYS. W70-00888	04A	
HIGHWAYS, FERRIES, WATERWAYS. W70-00948	06E	
BRIDGES - BOUNDARY AND OTHER WATERS. W70-00951	06E	
CONSTRUCTION, OPERATION, AND MAINTENANCE OF TOLL BRIDGES		

BRI-CLA

SUBJECT INDEX

OVER PEARL RIVER. W70-01152	06E	MEASUREMENT METHODS, W70-00875	08B
BUILDING PLUMBING SEPARATION REPORT ON PRESSURE SEWERAGE SYSTEM, SUMMER STREET SEPARATION STUDY AREA, BOSTON, MASSACHUSETTS, W70-01051	08A	CAVITATION RESISTANCE INCREASING THE CAVITATION RESISTANCE OF PARTS BY USING EXPLOSIVE-WELDED FACINGS, W70-01127	08C
SEPARATION OF COMBINED WASTEWATER AND STORM DRAINAGE SYSTEMS, SAN FRANCISCO STUDY AREA. W70-01053	08A	CENTRAL ARIZONA PROJECT THE ECONOMICS OF ARIZONA'S WATER PROBLEM, W70-01200	06D
BUOYS STAKES AND BUOYS. W70-01185	06E	PATTERNS OF WATER USE IN THE ARIZONA ECONOMY, W70-01202	06D
BURNING INCREASES IN MAXIMUM STREAM TEMPERATURES AFTER SLASH BURNING IN A SMALL EXPERIMENTAL WATERSHED, W70-01220	07C	CENTRAL ASIA A SCHEME OF GEOTHERMAL WATERS OF CENTRAL ASIA (RUSSIAN), W70-00869	02F
BUTTERFLY VALVES CONTROL TECHNIQUES FOR PRESSURIZED SEWERAGE SYSTEMS, W70-01064	08C	CHANNEL IMPROVEMENT FLOOD CONTROL. W70-01153	04A
CALCIUM CARBONATE CALCIUM CARBONATE INTERACTION WITH ORGANIC COMPOUNDS, W70-01069	02K	IMPROVEMENT OF NAVIGABILITY OF STREAMS. W70-01180	04A
CALIFORNIA FLOOD PLAIN INFORMATION, TROUT AND BIJOU CREEKS, SOUTH LAKE TAHOE, CALIFORNIA. W70-00856	04A	CHANNELS PROPAGATION OF WAVE-FRONTS IN WIDE CHANNELS OF ARBITRARY CROSS-SECTION, W70-00872	08B
GROUNDWATER IN SANTA BARBARA COUNTY, CALIFORNIA, SPRING 1967 TO SPRING 1968, W70-00989	07C	STAKES AND BUOYS. W70-01185	06E
LAND SUESIDENCE DUE TO GROUND-WATER WITHDRAWAL, TULARE-WASCO AREA, CALIFORNIA, W70-01013	02F	CHAPARRAL SOIL SLIPPAGE AN INDICATOR OF SLOPE INSTABILITY ON CHAPARRAL WATERSHEDS OF SOUTHERN CALIFORNIA, W70-01196	02J
DESIGN OF CALIFORNIA AQUEDUCT, W70-01111	08A	CHECK VALVE ADVANCED DEVELOPMENT OF HOUSEHOLD PUMP-STORAGE-GRINDER UNIT (TASK 6), W70-01048	08C
SOIL SLIPPAGE AN INDICATOR OF SLOPE INSTABILITY ON CHAPARRAL WATERSHEDS OF SOUTHERN CALIFORNIA, W70-01196	02J	CHEMICAL ANALYSIS USE OF A SELECTIVE ION ELECTRODE FOR DETERMINATION OF NITRATE IN SOILS, W70-01075	05A
CALIFORNIA AQUEDUCT DESIGN OF CALIFORNIA AQUEDUCT, W70-01111	08A	CHEMICAL INDUSTRY WATER RESOURCES AND THE CHEMICAL INDUSTRY IN NEW JERSEY AN ECONOMETRIC AND ENGINEERING ANALYSIS, W70-01217	06D
CANADA WATER TEMPERATURE DURING THE MELTING OF LAKE ICE, W70-00852	02H	CHEMICAL PROCESSES CALCIUM CARBONATE INTERACTION WITH ORGANIC COMPOUNDS, W70-01069	02K
THE CONSTITUTIONAL ASPECTS OF WATER POLLUTION AND THE NEED FOR GOVERNMENTAL COOPERATION, W70-00915	05G	PERSISTENCE OF DIAZINON AND ZINOPHOS IN SOIL EFFECTS OF AUTOCLOAVING, TEMPERATURE, MOISTURE, AND ACIDITY, W70-01079	02K
CANAL CONSTRUCTION CONTROLLING THE EXPANSION OF DESICCATED CLAYS DURING CONSTRUCTION, W70-01112	08D	CHINA REGIONAL AND SEASONAL WATER SUPPLY IN THE TARIM BASIN AND ITS RELATION TO CULTIVATED LAND POTENTIALS, W70-01210	03F
CANAL EMBANKMENTS CONTROLLING THE EXPANSION OF DESICCATED CLAYS DURING CONSTRUCTION, W70-01112	08D	CHLORINATED HYDROCARBON PESTICIDES PATTERNS OF INSECTICIDE RESISTANCE IN THE MOSQUITOFISH, GAMBUSIA AFFINIS, W70-01226	05C
CANAL SEEPAGE FIELD EVALUATION OF SEEPAGE MEASUREMENT METHODS, W70-01236	04A	CHRONIC TOXICITY CHRONIC TOXICITY OF ZINC TO THE FATHEAD MINNOW, PIMEPHALES PROMELAS RAFINESQUE, W70-01229	05C
REVIEW OF METHODS FOR MEASURING AND PREDICTING SEEPAGE, W70-01238	04A	CIRCULAR PIPE ANALYTICAL SOLUTION FOR TURBULENT FLOW IN PIPES, W70-00870	08B
CANALS BILLS, DAMS, AND CERTAIN OTHER WORKS ON WATERCOURSES. W70-01178	04A	CITIES CONDAMNATION BY CITIES, COUNTIES, AND DISTRICTS FOR FLOOD CONTROL OR DRAINAGE. W70-00895	06E
CAPITAL COSTS ADVANCED DEVELOPMENT OF HOUSEHOLD PUMP-STORAGE-GRINDER UNIT (TASK 6), W70-01048	08C	THE CLIMATE OF CITIES A SURVEY OF RECENT LITERATURE, W70-00988	10
CATCHMENTS THE LAND AND WATER USE SURVEY OF NORTH-CENTRAL KORDOFAN (1961-66). W70-01198	03B	CLADDING INCREASING THE CAVITATION RESISTANCE OF PARTS BY USING EXPLOSIVE-WELDED FACINGS, W70-01127	08C
THE STUDY OF LOCAL WATERS IN THE DESERTS OF THE USSR, W70-01216	03B	CLAMS SEA FOODS. W70-00968	06E
CAVITATION DETECTION OF CAVITATION BY ACOUSTIC AND VIBRATION- MEASUREMENT METHODS, W70-00875	08B	CLASSIFICATION THE ANALYSIS AND CLASSIFICATION OF SLOPE PROFILE FORMS, W70-01040	02J
INCREASING THE CAVITATION RESISTANCE OF PARTS BY USING EXPLOSIVE-WELDED FACINGS, W70-01127	08C	CLAY MINERALS FORMATION OF HYDROXY-AL AND -FE INTERLAYERS IN MONTMORILLONITE AND VERMICULITE INFLUENCE OF PARTICLE SIZE AND TEMPERATURE, W70-01014	02K
CAVITATION CONTROL INCREASING THE CAVITATION RESISTANCE OF PARTS BY USING EXPLOSIVE-WELDED FACINGS, W70-01127	08C	CLAYS EFFECT OF POLYELECTROLYTES IN CONJUNCTION WITH BENTONITIC CLAY ON CONTAMINANTS REMOVAL FROM SECONDARY EFFLUENTS,	
CAVITATION DETECTION DETECTION OF CAVITATION BY ACOUSTIC AND VIBRATION-			

W70-00845	05D	W70-00974	06E
THE RELATIONSHIP BETWEEN THE ULTIMATE RESISTIVITY OF CLAYEY SANDSTONES AND THEIR POROSITY AND CLAY CONTENTS (RUSSIAN), W70-00876	07B	FISH AND FISHING GENERALLY	FISH FOR MANUFACTURE INTO FISH MEAL, OIL.
ESTIMATION OF CLAY CONTENT OF SAND FORMATIONS FROM WELL-LOGGING DATA (RUSSIAN), W70-00877	07B	W70-00975	06E
DISTINGUISHING MARINE AND FRESHWATER MUDS, W70-00994	02K	FISH AND FISHING GENERALLY	TROLLS, TRAWL NETS, AND DRAG NETS.
CLEANING MARINE BIRDS		W70-00976	06E
OIL POLLUTION OF THE SEA IS THE END IN SIGHT, W70-01230	05C	FISH AND FISHING GENERALLY	MARKING OF BOATS, NETS, AND OTHER DEVICES.
CLEANING PROCEDURES		W70-00977	06E
FINAL REPORT TO THE AMERICAN SOCIETY OF CIVIL ENGINEERS ON TASK 7 AND TASK 9 OF THE COMBINED SEWER SEPARATION PROJECT, W70-01043	08A	FISH, OYSTERS, SHELLFISH, AND OTHER MARINE LIFE	MARINE RESOURCES COMMISSION AND COMMISSIONER OF MARINE RESOURCES.
CLEARCUTTING		W70-01161	03E
INCREASES IN MAXIMUM STREAM TEMPERATURES AFTER SLASH BURNING IN A SMALL EXPERIMENTAL WATERSHED, W70-01220	07C	COMMERCIAL SHELLFISH	
CLIMATES		SEA FOODS OYSTERS.	
THE CLIMATE OF CITIES A SURVEY OF RECENT LITERATURE, W70-00988	10	W70-00970	06E
CITY AIR - BETTER OR WORSE, W70-01239	05B	TAKING OYSTERS GENERALLY.	
CLIMATIC DATA		W70-00978	06E
THE CLIMATE OF CITIES A SURVEY OF RECENT LITERATURE, W70-00988	10	OYSTER RECORDS AND TAXES.	
CLIMATOLOGY		W70-00979	06E
NOCTURNAL AIR TEMPERATURE ON A FORESTED MOUNTAIN SLOPE, W70-01219	02B	CARRYING OYSTERS FROM STATE OR CERTAIN GROUNDS.	
CLOSED CONDUIT FLOW		W70-00980	06E
EXPERIMENTAL RESEARCH ON SPILLWAY SHAFT FLOW (FRENCH), W70-00873	08B	LEASING OYSTER-PLANTING GROUNDS.	
CLOUDS		W70-01164	03E
SOME OBSERVATIONS OF CLOUD INITIATION IN INDUSTRIAL AREAS, W70-01240	05C	TRANSFER OF OYSTER-PLANTING LEASES	RIGHTS OF RIPARIANS.
COAGULATION		W70-01165	03E
EFFECT OF POLYELECTROLYTES IN CONJUNCTION WITH BENTONITIC CLAY ON CONTAMINANTS REMOVAL FROM SECONDARY EFFLUENTS, W70-00845	05D	CULLING OYSTERS.	
COASTAL ENGINEERING		W70-01166	03E
CONSTRUCTION OF PORT FACILITIES.		COMMUNITORS	
W70-01183	04A	EXPERIENCE WITH GRINDING AND PUMPING OF SEWAGE FROM BUILDINGS,	
COASTAL PLAINS		W70-01056	08C
THE WATER-TABLE AQUIFER IN THE EASTERN COASTAL AREA OF BELGIUM, W70-00986	02F	COMMON LAW	
COASTAL WATERS		PRIVATE WATER RIGHTS IN FRANCE AND IN THE EASTERN UNITED STATES,	
THE FEDERAL GOVERNMENT AND AIR AND WATER POLLUTION, W70-01136	05G	W70-00916	06B
COLOR		W70-00917	06B
STUDIES ON ALgal SUBSTANCES IN THE SEA. I. GELBSTOFF (HUMIC MATERIAL) IN TERRESTRIAL AND MARINE WATERS, W70-01074	05B	W70-00919	06B
COLOR PHOTOGRAPHY		COMPACTION	
MULTISENSOR ANALYSIS FOR SOILS MAPPING,	07B	LAND SUBSIDENCE DUE TO GROUND-WATER WITHDRAWAL, TULARE-WASCC AREA, CALIFORNIA,	
W70-01125		W70-01013	02F
COLORADO		COMPENSATION	
RECORDS OF SELECTED WELLS AND SPRINGS IN THE BULISON PROJECT AREA, GARFIELD AND MESA COUNTIES, COLORADO.	07C	CONSTITUTIONAL LAW--COMMERCE CLAUSE--WATER RIGHTS IN THE FLOW OF A NON-NAVIGABLE STREAM ARE PROPERTY RIGHTS,	
COLUMBIA RIVER		W70-00922	04A
MEASUREMENT OF COLUMBIA RIVER FLOW TIME FROM HANFORD REACTORS TO ASTORIA, OREGON-SUMMER 1966,	02E	THE NAVIGATION SERVITUDE AND JUST COMPENSATION STRUGGLE FOR A DOCTRINE,	
W70-01002		W70-01144	04A
THE LAKE MISSOURIA FLOODS AND THE CHANNELLED SCABLAND,	02J	W70-01145	04A
W70-01012		COMPETING USES	
COMBINED SEWER LENGTHS		THE DILEMMA OF WATER RECREATION AND A SUGGESTED SOLUTION,	
STUDY OF APPROXIMATE LENGTHS AND SIZES OF COMBINED SEWERS IN MAJOR METROPOLITAN CENTERS,	08A	W70-00930	06D
W70-01057		COMPUTER PROGRAMS	
COMBINED SEWERS		CATAF SYSTEM CONTROLS FOR REGULATION OF COMBINED SEWAGE FLOWS,	
OUTLINE DESCRIPTION OF ASCE PROJECT ON "SEPARATION OF SANITARY SEWAGE FROM COMBINED SYSTEMS OF SEWERAGE".	08A	W70-00889	05D
W70-01054		COMPUTER PROGRAM FOR PLOTTING TIME DEPENDENT DATA WITH INSTRUCTION AND EXAMPLES,	
STUDY OF APPROXIMATE LENGTHS AND SIZES OF COMBINED SEWERS IN MAJOR METROPOLITAN CENTERS,	08A	W70-01008	07C
W70-01057		CONCRETE DAMS	
COMMERCIAL FISH		CRACKS IN BLOCKS OF THE BRATSK HYDROELECTRIC STATION DAM,	
FISH AND FISHING GENERALLY		W70-01119	08F
NETS.		CONDENMATION	
W70-00976	06E	CONDENMATION BY CITIES, COUNTIES, AND DISTRICTS FOR FLOOD CONTROL OR DRAINAGE.	
COMMERCIAL FISHING		W70-00895	06E
INSPECTION DISTRICTS		CONDENMATION BY CITIES AND COUNTIES TO PROVIDE WATERSHEDS OR BEDS FOR WATER PIPES.	
POLICE FLEET.		W70-00973	04A
		THE NAVIGATION SERVITUDE AND JUST COMPENSATION STRUGGLE FOR A DOCTRINE,	
		W70-01144	04A
		W70-01145	04A
		NEW JERSEY TURNPIKE AUTHORITY V SISSLERMAN (CONDENMATION OF RIPARIAN LAND).	
		W70-01155	06E
		CONDENMATION VALUE	
		THE NAVIGATION SERVITUDE AND JUST COMPENSATION STRUGGLE FOR A DOCTRINE,	
		W70-01144	04A

CON-DES

SUBJECT INDEX

CONDUIT INSTALLATION FINAL REPORT TO THE AMERICAN SOCIETY OF CIVIL ENGINEERS ON TASK 7 AND TASK 9 OF THE COMBINED SEWER SEPARATION PROJECT, W70-01043	08A	W70-01070 05C
CONSERVATION CHALLENGES TO CREATIVE CONSERVATION, W70-01081	06G	DAM CONSTRUCTION WATER-POWER DEVELOPMENT, CONSERVATION OF HYDROELECTRIC POWER DAMS AND WORKS. W70-01175 06E
CONSTRUCTION MATERIALS FINAL REPORT TO THE AMERICAN SOCIETY OF CIVIL ENGINEERS ON TASK 7 AND TASK 9 OF THE COMBINED SEWER SEPARATION PROJECT, W70-01043	08A	THE ASWAN HIGH DAM, W70-01201 06B
CUMULATIVE USE THE CHANGING ROLE OF WATER IN ARID LANDS, W70-01199	06B	DAM DESIGN ROLE OF PROGNOSIS OF GROUNDWATER STATE IN PROJECTION OF DAMS (POLISH), W70-00874 08A
CONTINUOUS FLOW BIOASSAY CHRONIC TOXICITY OF ZINC TO THE FATHEAD MINNOW, PIMEPHALEUS PROMELAS RAPINESQUE, W70-01229	05C	DAM FACINGS DECKED ROCKFILL DAMS, W70-01121 08D
CONTROL SYSTEMS CONTROL TECHNIQUES FOR PRESSURIZED SEWERAGE SYSTEMS, W70-01064	08C	DAMAGES NATURAL FEATURES CAUSED BY A CATASTROPHIC STORM IN NELSON AND ANHESTER COUNTIES, VIRGINIA. W70-00992 02E
CONTROLLED EXPANSION CONTROLLING THE EXPANSION OF DESICCATED CLAYS DURING CONSTRUCTION, W70-01112	08D	OFFENSES AGAINST PROPERTY BY FORCE. W70-01149 06E
CONVERGENCE CONVERGENT STILLING BASINS, W70-01099	08B	DAMS DAMS. W70-00891 04A
CONVERGING FLOW CONVERGENT STILLING BASINS, W70-01099	08B	DATA COLLECTIONS RECORDS OF SELECTED WELLS AND SPRINGS IN THE RULISON PROJECT AREA, GARFIELD AND MESA COUNTIES, COLORADO, W70-00987 07C
COOLING TOWER COPING WITH COOLING TOWER BLOWDOWN, W70-00884	05D	GROUNDWATER IN SANTA BARBARA COUNTY, CALIFORNIA, SPRING 1968 TO SPRING 1968, W70-00989 07C
COOLING TOWERS COOLING TOWERS FOR STEAM-ELECTRIC STATIONS - ECONOMIC APPLICATIONS, W70-00887	05D	DIGITIZED PHYSICAL DATA OF A RANGELAND WATERSHED, W70-00993 07C
CORROSION INHIBITOR COPING WITH COOLING TOWER BLOWDOWN, W70-00884	05D	RELATIONSHIP OF SEWAGE CHARACTERISTICS TO CARRYING VELOCITY FOR PRESSURE SEWERS, W70-01047 08B
COST ANALYSES COMBINED SEWER SEPARATION PROJECT, REPORT ON MILWAUKEE STUDY AREA. W70-01052	08A	SAMPLING AND ANALYSIS OF WASTE WATER FROM INDIVIDUAL HOMES (TASK 2), W70-01050 08B
COST ANALYSIS NUCLEAR POWER PLANT SITING IN THE PACIFIC NORTHWEST FOR THE BONNEVILLE POWER ADMINISTRATION, W70-00883	05D	SEWAGE FLOW VARIATIONS IN INDIVIDUAL HOMES, W70-01055 08B
REPORT ON PRESSURE SEWERAGE SYSTEM, SUMMER STREET SEPARATION STUDY AREA, BOSTON, MASSACHUSETTS, W70-01051	08A	DATA PROCESSING DIGITIZED PHYSICAL DATA OF A RANGELAND WATERSHED, W70-00993 07C
SEPARATION OF COMBINED WASTEWATER AND STORM DRAINAGE SYSTEMS, SAN FRANCISCO STUDY AREA. W70-01053	08A	COMPUTER PROGRAM FOR PLOTTING TIME DEPENDENT DATA WITH INSTRUCTION AND EXAMPLES, W70-01008 07C
COSTS SPECIAL REQUIREMENTS FOR A FULL SCALE FIELD DEMONSTRATION OF THE ASCE COMBINED SEWER SEPARATION PROJECT SCHEME, W70-01066	08A	DECISION MAKING WATER QUALITY AND REGIONAL ECONOMY, A DECISION MODEL, W70-00897 05G
COST-BENEFIT ANALYSIS EVALUATION OF BENEFITS OF A FLOOD WARNING SYSTEM, W70-00838	06B	A SYSTEMS APPROACH TO WASTE MANAGEMENT, W70-00898 05D
AN EXAMINATION OF THE BENEFITS AND DISADVANTAGES WITH RESPECT TO THE DISPOSAL OF SOLID WASTES, W70-01063	05D	A CONJUNCTIVE OPERATION OF A SURFACE RESERVOIR AND A GROUNDWATER AQUIFER, W70-00906 02A
COST-BENEFIT RATIO THE ECONOMICS OF ARIZONA'S WATER PROBLEM, W70-01200	06D	DEFORMATION A SEMI-EMPIRICAL METHOD FOR DETERMINING STRESSES BENEATH EMBANKMENTS, W70-01102 08D
CRACK CONTROL CRACKS IN BLOCKS OF THE BRATSK HYDROELECTRIC STATION DAM, W70-01119	08F	A LABORATORY INVESTIGATION OF BOREHOLE STABILITY, W70-01107 08E
CRACKS CRACKS IN BLOCKS OF THE BRATSK HYDROELECTRIC STATION DAM, W70-01119	08F	RELATION BETWEEN THE STATIC AND THE DYNAMIC DEFORMATION INDEXES OF ROCK IN LARGE-SCALE TESTS ON ROCK MASSES, W70-01124 08E
CULTIVATED LANDS EFFECTS OF CULTIVATION AND GRASS ON SURFACE RUNOFF, W70-00863	04A	DEFORMATION MODULUS RELATION BETWEEN THE STATIC AND THE DYNAMIC DEFORMATION INDEXES OF ROCK IN LARGE-SCALE TESTS ON ROCK MASSES, W70-01124 08E
CULTIVATION EFFECTS OF CULTIVATION AND GRASS ON SURFACE RUNOFF, W70-00863	04A	DENSITY CURRENTS NEW PROBLEMS IN THE THEORY OF BOTTOM CURRENTS IN RESERVOIRS, W70-01129 08B
CUTTING ELECTRON BEAMS APPLY AN OLD PRINCIPLE TO MODERN ROCK- BREAKING, W70-01109	08H	DEPOSITION(SEWAGE SEDIMENTS) RELATIONSHIP OF SEWAGE CHARACTERISTICS TO CARRYING VELOCITY FOR PRESSURE SEWERS, W70-01047 08B
CYANOPHYTA NITROGEN FIXATION BY GLOEOPCAPSA,		MINIMUM TRANSPORT VELOCITY FOR PRESSURIZED SANITARY SEWERS, W70-01060 08B
		DEPOSITION(SOLID WASTES) AN EXAMINATION OF THE BENEFITS AND DISADVANTAGES WITH RESPECT TO THE DISPOSAL OF SOLID WASTES, W70-01063 05D
		DESALINATION PROCESSES EXPERIMENTAL STUDY OF SLURRY SEPARATORS FOR USE IN DESALINATION, W70-00892 03A

DESERTS		
THE WATER PROBLEM IN THE DESERTS OF THE USSR, W70-01215	03B	
THE STUDY OF LOCAL WATERS IN THE DESERTS OF THE USSR, W70-01216	03B	
DESIGN		
DYNAMIC ASPECTS OF URBAN WATER DEMAND, W70-00899	06D	
DEVELOP AND FIELD TEST METHOD OF INSTALLING PRESSURE CONDUITS IN COMBINED SEWERS, W70-01044	08A	
ADVANCED DEVELOPMENT OF HOUSEHOLD PUMP-STORAGE-GRINDER UNIT (TASK 6), W70-01048	08C	
REPORT ON PRESSURE SEWERAGE SYSTEM, SUMMER STREET SEPARATION STUDY AREA, BOSTON, MASSACHUSETTS, W70-01051	08A	
SEPARATION OF COMBINED WASTEWATER AND STORM DRAINAGE SYSTEMS, SAN FRANCISCO STUDY AREA. W70-01053	08A	
DESIGN CRITERIA		
DOMESTIC SEWAGE FLOW CRITERIA FOR EVALUATION OF PROJECT SCHEME TO ACTUAL COMBINED SEWER DRAINAGE AREAS, W70-01061	08B	
DEVELOPMENT		
DEVELOP AND FIELD TEST METHOD OF INSTALLING PRESSURE CONDUITS IN COMBINED SEWERS, W70-01044	08A	
ADVANCED DEVELOPMENT OF HOUSEHOLD PUMP-STORAGE-GRINDER UNIT (TASK 6), W70-01048	08C	
DIAGENESIS		
DIAGENETIC CHANGES IN INTERSTITIAL WATERS OF HOLOCENE LAKE CONSTANCE SEDIMENTS, W70-01009	02H	
DIAZINON		
PERSISTENCE OF DIAZINON AND ZINOPHOS IN SOIL EFFECTS OF AUTOCLAVING, TEMPERATURE, MOISTURE, AND ACIDITY, W70-01079	02K	
DIFFUSION		
THE PREDICTION OF THE DISTRIBUTION OF DISSOLVED OXYGEN IN RIVERS, W70-01033	05B	
ON THE DIFFUSION PHENOMENA IN BOUNDARY LAYERS OF TURBULENT FLOW AND ITS INFLUENCE ON THE COURSE OF THE SELF- PURIFICATION OF SMALL STREAMS, W70-01037	05C	
DIGITAL COMPUTERS		
DIGITIZED PHYSICAL DATA OF A RANGELAND WATERSHED, W70-00993	07C	
COMPUTER PROGRAM FOR PLOTTING TIME DEPENDENT DATA WITH INSTRUCTION AND EXAMPLES, W70-01008	07C	
IMPROVED DIGITAL SIMULATION FOR ANALYZING POWER SYSTEM DISTURBANCES, W70-01105	08C	
DIGITAL SIMULATION		
THE USE OF A DIGITAL SIMULATION SYSTEM FOR THE MODELING AND PREDICTION OF WATER QUALITY, W70-01030.	05A	
DIRECT SHEAR		
STRENGTH OF DISCONTINUOUS ROCKS IN DIRECT SHEAR, W70-01101	08E	
DISPERSION		
AN ESTIMATION OF WIND EFFECTS ON DISPERSION IN WIDE CHANNELS, W70-00842	02E	
DISSOLVED OXYGEN		
A RAPID FOR MEASURING THE ACUTE TOXICITY OF DISSOLVED MATERIALS TO MARINE FISHES, W70-00849	05A	
THE INFLUENCE OF SUSPENDED SOLIDS ON THE RATE OF OXYGEN TRANSFER IN AQUEOUS SOLUTIONS, W70-01023	05D	
STREAM REAERATION USING MOLECULAR OXYGEN, W70-01028	05G	
THE PREDICTION OF THE DISTRIBUTION OF DISSOLVED OXYGEN IN RIVERS, W70-01033	05B	
DISTRIBUTION SYSTEMS		
A WATER DISTRIBUTION SYSTEM FOR COLD REGIONS, THE SINGLE MAIN RECIRCULATING METHOD. AN HISTORICAL REVIEW, FIELD EVALUATION, AND SUGGESTED DESIGN PROCEDURES, W70-01088	04A	
DIURETICS		
THE DIURPFIC RESPONSE BY RAINBOW TROUT TO SUB-LETHAL CONCENTRATIONS OF AMMONIA, W70-00848	05C	
DOMESTIC WATER		
VILLAGE WATER SUPPLY INVESTIGATION, TERRITORY OF PAPUA AND NEW GUINEA, W70-00991	03B	
DOMESTIC WATER USE		
DOMESTIC SEWAGE FLOW CRITERIA FOR EVALUATION OF PROJECT SCHEME TO ACTUAL COMBINED SEWER DRAINAGE AREAS, W70-01061	08B	
DOUBLE-CURVATURE ARCH DAMS		
THE SEISMIC DESIGN STUDY OF A DOUBLE CURVATURE ARCH DAM, W70-01094	08A	
DRAINAGE		
A NUMERICAL METHOD FOR ESTIMATING INFILTRATION, REDISTRIBUTION, DRAINAGE, AND EVAPORATION OF WATER FROM SOIL, W70-00862	02G	
WATER AND WATER COURSES--SERVITUDES--ARTICLE 660, LOUISIANA CIVIL CODE OF 1870. W70-00929	04A	
WESTPHAL V SCHMALZ (UNAUTHORIZED USE OF DRAINAGE SYSTEM). W70-00971	04A	
DRAINAGE BASIN MORPHOLOGY		
FREQUENCY DISTRIBUTIONS OF STREAM LINK LENGTHS, W70-01006	02J	
DRAINAGE DISTRICTS		
DRAINAGE-SELECTION, QUALIFICATIONS, POWERS, AND DUTIES OF COMMISSIONERS AND OTHER OFFICERS. W70-00941	04A	
DRAINAGE DISTRICTS.		
W70-00952	04A	
SWAMP LAND DISTRICTS..		
W70-00953	04A	
FLOOD CONTROL - DRAINAGE DISTRICTS.		
W70-00954	04A	
DRAINAGE ENGINEERING		
DRAINAGE DISTRICTS. W70-00952	04A	
DRAINAGE PATTERNS(GEOLOGIC)		
FREQUENCY DISTRIBUTIONS OF STREAM LINK LENGTHS, W70-01006	02J	
DRAINAGE PROGRAMS		
DRAINAGE DISTRICTS. W70-00952	04A	
DRAINAGE SERVITUDE		
WATER AND WATER COURSES--SERVITUDES--ARTICLE 660, LOUISIANA CIVIL CODE OF 1870. W70-00929	04A	
DRAINAGE SYSTEMS		
DRAINAGE-SELECTION, QUALIFICATIONS, POWERS, AND DUTIES OF COMMISSIONERS AND OTHER OFFICERS. W70-00941	04A	
WESTPHAL V SCHMALZ (UNAUTHORIZED USE OF DRAINAGE SYSTEM). W70-00971	04A	
JURISDICTION OF COUNTY DRAINAGE BOARDS. W70-01150	04A	
DRAINAGE WATER		
STOUDER V DASHNER (DOMINANT VERSUS SERVIENT LAND RIGHTS RELATING TO DRAINAGE OF SURFACE WATERS). W70-01146	04A	
DREDGING		
DREDGING SAND AND GRAVEL AND MISCELLANEOUS OFFENSES (WATER POLLUTION) W70-01181	05G	
DRIFTING(AQUATIC)		
NONLINEAR THEORY OF WIND DRIFT OF ICE (RUSSIAN). W70-01018	02C	
DRILL HOLES		
A LABORATORY INVESTIGATION OF BOREHOLE STABILITY. W70-01107	08E	
DRILLING		
WATER RESOURCES. W70-01156	04B	
DRINKING WATER TREATMENT		
RADIOTRACER STUDY OF RAPID SAND FILTRATION. W70-00910	05D	
DROUGHT FREQUENCY CURVES		
FREQUENCY ANALYSES OF FLOODS AND DROUGHTS. W70-01120	02E	
DROUGHTS		
FREQUENCY ANALYSES OF FLOODS AND DROUGHTS. W70-01120	02E	

DROWNED(SUBMERGED)	IMPROVED DIGITAL SIMULATION FOR ANALYZING POWER SYSTEM DISTURBANCES,	08C
CONVERGENT STILLING BASINS,	W70-01099	08B
DYNAMIC PROGRAMMING	ELECTRODES(SELECTIVE ION)	
AQUDUCT ROUTE OPTIMIZATION BY DYNAMIC PROGRAMMING,	USE OF A SELECTIVE ION ELECTRODE FOR DETERMINATION OF NITRATE IN SOILS,	05A
W70-00894	W70-01075	
APPLICATION OF DYNAMIC PROGRAMMING TO THE CONTROL OF WATER RESOURCES SYSTEMS,	ELECTRON BEAMS	
W70-00903	ELECTRON BEAMS APPLY AN OLD PRINCIPLE TO MODERN ROCK-BREAKING,	08H
A CONJUNCTIVE OPERATION OF A SURFACE RESERVOIR AND A GROUNDWATER AQUIFER,	W70-01109	
W70-00906	ELECTRON(BEAM CUTTING)	
STOCHASTIC METHODS FOR ANALYZING RIVER BASIN SYSTEMS,	ELECTRON BEAMS APPLY AN OLD PRINCIPLE TO MODERN ROCK-BREAKING,	08H
W70-01085	W70-01109	
DYNAMICS	EMBANKMENTS	
THE DYNAMICS OF QUATERNARY SLOPE EVOLUTION AND ITS GEOMORPHOLOGICAL REPRESENTATION,	A SEMI-EMPIRICAL METHOD FOR DETERMINING STRESSES BENEATH EMBANKMENTS,	08D
W70-01041	W70-01102	
EARTH DAMS	EMINENT DOMAIN	
DETERMINING PORE PRESSURE IN SLIGHTLY PERMEABLE SOILS IN THE BODY OF A DAM DURING THE PROCESS OF THEIR CONSOLIDATION,	FLOOD CONTROL - DRAINAGE DISTRICTS.	04A
W70-01091	W70-00954	
EASEMENTS	RIGHT OF EMINENT DOMAIN OF PUBLIC SERVICE CORPORATIONS.	06E
NAVIGABLE WATERS--ARTIFICIAL LAKE CONNECTED TO RIVER,	W70-01176	
W70-00937	ENERGY LOSSES	
ECCENTRICITY	HEAD LOSSES CAUSED BY AN ICE COVER ON OPEN CHANNELS,	08B
ANALYTICAL STUDIES OF TURBULENT FRICTION IN ANNULAR CONDUITS,	W70-01126	
W70-01045	ENGINEERING GEOLOGY	
ECOLOGY	CERTAIN ASPECTS OF ENGINEERING GEOLOGY IN PERMAFROST,	08D
THE INFLUENCE OF ALGAL ANTIBIOSIS ON THE ECOLOGY OF MARINE MICROORGANISMS,	W70-01011	
W70-01068	EQUATIONS	
CHALLENGES TO CREATIVE CONSERVATION,	MODIFIED RUBEY'S LAW ACCURATELY PREDICTS SEDIMENT SETTLING	02J
W70-01081	VELOCITIES,	
THE ENVIRONMENT--AND WHAT TO DO ABOUT IT,	W70-00855	
W70-01106	EROSION	
ECONOMIC EFFICIENCY	THE DYNAMICS OF QUATERNARY SLOPE EVOLUTION AND ITS GEOMORPHOLOGICAL REPRESENTATION,	02J
COOLING TOWERS FOR STEAM-ELECTRIC STATIONS - ECONOMIC APPLICATIONS,	W70-01041	
W70-00887	PLEISTOCENE ACTIVITY AND HOLOCENE STABILITY OF HILLSLOPES, WITH EXAMPLES FROM SCANDINAVIA AND PENNSYLVANIA,	02J
ECONOMIC FEASIBILITY	W70-01042	
STATUTORY STREAM POLLUTION CONTROL,	EROSIONS	
W70-00926	SHEETFLOODS, STREAMFLOODS, AND THE FORMATION OF PEDIMENTS,	02J
ECONOMIC JUSTIFICATION	W70-01211	
NON-MECHANICAL CONSIDERATIONS INVOLVED IN IMPLEMENTING PRESSURIZED SEWERAGE SYSTEMS,	ESTUARINE ENVIRONMENT	
W70-01065	MATHEMATICAL SIMULATION OF THE ESTUARINE BEHAVIOR AND ITS APPLICATIONS,	05C
ECONOMICS	W70-00896	
THE ECONOMICS OF ARIZONA'S WATER PROBLEM,	EUGLENAE	
W70-01200	A COMPOSITE RATING OF ALGAE TOLERATING ORGANIC POLLUTION,	05C
PATTERNS OF WATER USE IN THE ARIZONA ECONOMY,	W70-01233	
W70-01202	EUTROPHICATION	
THE DEVELOPMENT OF THE IRRIGATION ECONOMY OF MENDOZA, ARGENTINA,	STRONTIUM-90 CONCENTRATION FACTORS OF LAKE PLANKTON, MACROPHYTES, AND SUBSTRATES,	05C
W70-01213	W70-01010	
EFFECTS	STUDIES ON NATURAL FACTORS AFFECTING PHOSPHATE ABSORPTION AND ITS UTILIZATION BY ALGAE,	05C
WATER QUALITY CRITERIA FOR EUROPEAN FRESHWATER FISH - WATER TEMPERATURE AND INLAND FISHERIES.	W70-01031	
W70-00880	CAUSES AND CONSEQUENCES OF POND EUTROPHICATION (POLISH),	05F
EGYPT	W70-01082	
NEW WATER BIRD FOR EGYPT A ROBOT SHADOOF,	EVALUATION	
W70-01205	FIELD EVALUATION OF SEEPAGE MEASUREMENT METHODS,	04A
ELASTICITY MODULUS	W70-01236	
RELATION BETWEEN THE STATIC AND THE DYNAMIC DEFORMATION INDEXES OF ROCK IN LARGE-SCALE TESTS ON ROCK MASSSES,	EVAPORATION	
W70-01124	A NUMERIC METHOD FOR ESTIMATING INFILTRATION, REDISTRIBUTION, DRAINAGE, AND EVAPORATION OF WATER FROM SOIL,	02G
ELECTRICAL DESIGN	W70-00862	
ELECTRICAL DESIGN OF PARAMETERS USED FOR EHV SYSTEMS,	AN EMPIRICAL METHOD FOR ESTIMATING MONTHLY POTENTIAL EVAPOTRANSPIRATION IN NEVADA,	02D
W70-01093	W70-01004	
ELECTRICAL RESISTANCE	EXCAVATION	
THE RELATIONSHIP BETWEEN THE ULTIMATE RESISTIVITY OF CLAYPY SANDSTONES AND THEIR POROSITY AND CLAY CONTENTS (RUSSIAN).	GROUNDWATER MOVEMENT TOWARD ARTIFICIAL CUTS,	02F
W70-00876	W70-00858	
ELECTRICAL STABILITY	EXPANSION	
IMPROVED DIGITAL SIMULATION FOR ANALYZING POWER SYSTEM DISTURBANCES,	A LABORATORY INVESTIGATION OF BOREHOLE STABILITY,	08E
W70-01105	W70-01107	
ELECTRICAL STUDIES	EXPANSIVE CLAYS	
ON THE POSSIBILITY OF ESTIMATING THE THICKNESS OF UNCONSOLIDATED ROCKS BY VERTICAL ELECTRICAL SOUNDING IN PERMAFROST AREAS (RUSSIAN).	HYDROSTATICS AND HYDRODYNAMICS IN SWELLING SOILS,	02G
W70-00878	W70-00841	
THE WATER-TABLE AQUIFER IN THE EASTERN COASTAL AREA OF BELGIUM,	CONTROLLING THE EXPANSION OF DESICCATED CLAYS DURING CONSTRUCTION,	02F
W70-00986		

		SUBJECT INDEX	EXP-FIS
W70-01112	08D	BREAKTHROUGH IN FOOD PRODUCTION IN TROPICAL, SUBTROPICAL AND DESERT AREAS, W70-01218	03F
EXPANSIVE SOILS HYDROSTATICS AND HYDRODYNAMICS IN SWELLING SOILS, W70-00841	02G		
EXPLORATION ESTIMATION OF CLAY CONTENT OF SAND FORMATIONS FROM WELL-LOGGING DATA (RUSSIAN), W70-00877	07B		
ON THE POSSIBILITY OF ESTIMATING THE THICKNESS OF UNCONSOLIDATED ROCKS BY VERTICAL ELECTRICAL SOUNDING IN PERMAFROST AREAS (RUSSIAN), W70-00878	07B		
THE WATER-TABLE AQUIFER IN THE EASTERN COASTAL AREA OF BELGIUM, W70-00986	02F		
ON THE PRESENT OPTIMUM VARIANT IN HYDROGEOLOGICAL EXPLORATION (GERMAN), W70-01022	07C		
SURFACE AND SUBSURFACE EXPLORATION BY INFRARED SURVEYS, W70-01128	07B		
EXPLOSIVE WELDING INCREASING THE CAVITATION RESISTANCE OF PARTS BY USING EXPLOSIVE-WELDED FACINGS, W70-01127	08C		
EXTRA HIGH VOLTAGE ELECTRICAL DESIGN OF PARAMETERS USED FOR EHV SYSTEMS, W70-01093	08C		
EXTRACELLULAR STUDIES ON ALGAL SUBSTANCES IN THE SEA. III. THE PRODUCTION OF EXTRACELLULAR ORGANIC MATTER BY LITTORAL MARINE ALGAE, W70-01073	05B		
EXUDATION STUDIES ON ALGAL SUBSTANCES IN THE SEA. II. THE FORMATION OF GELBSTOFF (HUMIC MATERIAL) BY EXUDATES OF PHAEOPHYTA, W70-01072	05B		
FACINGS DECKED ROCKFILL DAMS, W70-01121	08D		
FARM EQUIPMENT NEW WATER BIRD FOR EGYPT A ROBOT SHADOOF, W70-01205	03P		
FATHEAD MINNOW CHRONIC TOXICITY OF ZINC TO THE FATHEAD MINNOW, PIMEPHALE PROMELAS RAFINESQUE, W70-01229	05C		
FEDERAL GOVERNMENT GOVERNMENTAL TECHNIQUES FOR THE CONSERVATION AND UTILIZATION OF WATER RESOURCES AN ANALYSIS AND PROPOSAL. W70-00934	06B		
THE FEDERAL GOVERNMENT AND AIR AND WATER POLLUTION, W70-01136	05G		
FEDERAL WATER RESOURCES DEVELOPMENT. W70-01179	06B		
FEDERAL JURISDICTION FEDERAL REGULATION OF WATERWAYS. W70-00928	04A		
THE FEDERAL GOVERNMENT AND AIR AND WATER POLLUTION, W70-01136	05G		
THE NAVIGATION SERVITUDE AND JUST COMPENSATION STRUGGLE FOR A DOCTRINE, W70-01144	04A		
FEDERAL JURISDICTION THE NAVIGATION SERVITUDE AND JUST COMPENSATION STRUGGLE FOR A DOCTRINE, W70-01145	04A		
FEDERAL POWER ACT THE NAVIGATION SERVITUDE AND JUST COMPENSATION STRUGGLE FOR A DOCTRINE, W70-01145	04A		
FEDERAL-STATE WATER RIGHTS CONFLICTS THE CONSTITUTIONAL ASPECTS OF WATER POLLUTION AND THE NEED FOR GOVERNMENTAL COOPERATION, W70-00915	05G		
GOVERNMENTAL TECHNIQUES FOR THE CONSERVATION AND UTILIZATION OF WATER RESOURCES AN ANALYSIS AND PROPOSAL. W70-00936	06B		
PERRIES STATE HIGHWAYS. W70-00888	04A		
FERTILIZATION CAUSES AND CONSEQUENCES OF POND EUTROPHICATION (POLISH), W70-01082	05P		
FERTILIZERS TRICKLE IRRIGATION -- A PROMISING SECOND TOOL FOR A			
		FIELD DEMONSTRATION PLANNING SPECIAL REQUIREMENTS FOR A FULL SCALE FIELD DEMONSTRATION OF THE ASCE COMBINED SEWER SEPARATION PROJECT SCHEME, W70-01066	08A
		FIELD TESTS FIELD TEST RESULTS ON 113,000 KW FRANCIS PUMP-TURBINES FOR NAGANO POWER STATION, W70-01097	0RC
		FIELD EVALUATION OF SEEPAGE MEASUREMENT METHODS, W70-01236	04A
		FILTERING SYSTEM RADIOTRACER STUDY OF RAPID SAND FILTRATION, W70-00910	05D
		FILTERS MODIFIED FILTER MEDIA FROM REMOVAL OF WATER POLLUTANTS, W70-01027	05D
		FILTRATION USE OF MEMBRANE FILTERS IN GRAVIMETRIC ANALYSES OF PARTICULATE MATTER IN NATURAL WATERS, W70-00857	07B
		MODIFIED FILTER MEDIA FROM REMOVAL OF WATER POLLUTANTS, W70-01027	05D
		FINANCING TOMBIGEE RIVER VALLEY WATER MANAGEMENT DISTRICT. W70-00957	04A
		FISH FISH AND GAME (LICENSES). W70-00943	06E
		FISH (SEASONS, LIMITS, SPAWNING GROUNDS). W70-00944	06E
		COMMERCIAL FISHING DEVICES - REGULATIONS. W70-00946	06E
		SEA FOODS. W70-00968	06E
		FISH (LICENSES AND PERMITS). W70-01148	06E
		FISH, OYSTERS, SHELLFISH, AND OTHER MARINE LIFE MARINE RESOURCES COMMISSION AND COMMISSIONER OF MARINE RESOURCES. W70-01161	03E
		FISH LAWS. W70-01167	06E
		PATTERNS OF INSECTICIDE RESISTANCE IN THE MOSQUITOFISH, GAMBUSIA AFFINIS. W70-01226	05C
		WATER QUALITY CRITERIA FOR EUROPEAN FRESHWATER FISH REPORT ON WATER TEMPERATURE AND INLAND FISHERIES BASED MAINLY ON SLAVONIC LITERATURE. W70-01228	05C
		FISH CONSERVATION FISH POISONING POISONING WATER SUPPLY. W70-00949	05G
		SEA FOODS. W70-00967	06E
		FISHING PERMITS NATIONAL FORESTS. W70-00982	06E
		MARINE RESOURCES COMMISSION. W70-01162	03E
		FISH CONTROL AGENTS FISHERY MANAGEMENT WITH THE HELP OF THE ORGANOPHOSPHORUS INSECTICIDE, THIOMETON, W70-01232	05C
		FISH GROWTH CHRONIC TOXICITY OF ZINC TO THE FATHEAD MINNOW, PIMEPHALE PROMELAS RAFINESQUE, W70-01229	05C
		FISH MANAGEMENT FISHING PERMITS NATIONAL FORESTS. W70-00982	06E
		FISH LAWS. W70-01167	06E
		FISHERY MANAGEMENT WITH THE HELP OF THE ORGANOPHOSPHORUS INSECTICIDE, THIOMETON, W70-01232	05C
		FISH PHYSIOLOGY WATER QUALITY CRITERIA FOR EUROPEAN FRESHWATER FISH LIST OF LITERATURE ON THE EFFECT OF WATER TEMPERATURE ON FISH. W70-01227	05C
		FISH PRODUCTION CHRONIC TOXICITY OF ZINC TO THE FATHEAD MINNOW, PIMEPHALE PROMELAS RAFINESQUE.	

		SUBJECT INDEX
PIS-GRL	05C	W70-01064 08C
W70-01229		FLOW MEASUREMENT A STUDY OF HOT WIRE AND HOT FILM ANEMOMETERS IN WATER (FRENCH), W70-00868 07B
FISH REPRODUCTION CHRONIC TOXICITY OF ZINC TO THE FATHEAD MINNOW, <i>PIMEPHALES PROMELAS RAFINESQUE</i> , W70-01229	05C	FLOW RATES ANALYTICAL STUDIES OF TURBULENT FRICTION IN ANNULAR CONDUITS, W70-01045 08B
FISH SURVIVAL CHRONIC TOXICITY OF ZINC TO THE FATHEAD MINNOW, <i>PIMEPHALES PROMELAS RAFINESQUE</i> , W70-01229	05C	FLOW ROUTING ROUTING OF FLOWS IN SANITARY SEWERAGE SYSTEMS, W70-01067 08A
FISH WHEELS FISH LAWS. W70-01167	06E	FLUORESCENCE FLUORESCENT SAND AS A TRACER OF FLUVIAL SEDIMENT, W70-0C867 02J
FISHING FISH (SEASONS, LIMITS, SPawning GROUNDS)- W70-00944	06E	FLUVIAL SEDIMENTS FLUORESCENT SAND AS A TRACER OF FLUVIAL SEDIMENT, W70-00867 02J
INSPECTION DISTRICTS POLICE FLEET. W70-00974	06E	FOOTINGS UPLIFT RESISTANCE OF ANCHOR BAR, AUGER AND PRESSED PLATE FOOTINGS IN SANDY SILT, W70-01096 08C
FISH LAWS. W70-01167	06E	FOREST TEMPERATURES NOCTURNAL AIR TEMPERATURE ON A FORESTED MOUNTAIN SLOPE, W70-01219 02B
FISHING GEAR COMMERCIAL FISHING DEVICES - REGULATIONS. W70-00946	06E	FOUNDATION INVESTIGATIONS CONTROLLING THE EXPANSION OF DESICCATED CLAYS DURING CONSTRUCTION, W70-01112 08D
FITTINGS FINAL REPORT TO THE AMERICAN SOCIETY OF CIVIL ENGINEERS ON TASK 7 AND TASK 9 OF THE COMBINED SEWER SEPARATION PROJECT, W70-01043	08A	FOUNDATIONS A SEMI-EMPIRICAL METHOD FOR DETERMINING STRESSES BENEATH EMBANKMENTS, W70-01102 08D
FLASH DISTILLATION THE OPTIMUM TEMPERATURE FOR THE OPERATION OF A NON-SCALING MULTI-STAGE FLASH EVAPORATOR PLANT, W70-00907	03A	FRANCIS TURBINES FIELD TEST RESULTS ON 113,000 KW FRANCIS PUMP-TURBINES FOR NAGANO POWER STATION, W70-01097 08C
FLOCULATION EFFECT OF POLYELECTROLYTES IN CONJUNCTION WITH BENTONITIC CLAY ON CONTAMINANTS REMOVAL FROM SECONDARY EFFLUENTS, W70-00845	05D	FRASER RIVER IMPLICATION OF WATER QUALITY AND SALINITY IN THE SURVIVAL OF FRASER RIVER SOCKEYE SMOLTS, W70-01225 05C
FLCCD CONTROL CONDENRATION BY CITIES, COUNTIES, AND DISTRICTS FOR FLOOD CONTROL OR DRAINAGE. W70-00895	06E	FREE SURFACES NON-LINEAR FREE SURFACES IN OPEN CHANNELS (FRENCH), W70-00871 08B
FLOOD CONTROL - DRAINAGE DISTRICTS. W70-00954	04A	FRESH WATER STUDIES ON ALGAL SUBSTANCES IN THE SEA. I. GELBSTOFF (HUMIC MATERIAL) IN TERRESTRIAL AND MARINE WATERS, W70-01074 05B
FLOOD CONTROL. W70-01153	04A	SWEETWATER POLLUTION, W70-01104 05B
FLOOD DAMAGE FLOOD PLAIN INFORMATION, TROUT AND BIJOU CREEKS, SOUTH LAKE TAHOE, CALIFORNIA. W70-00856	04A	FRESHWATER FISH WATER QUALITY CRITERIA FOR EUROPEAN FRESHWATER FISH - WATER TEMPERATURE AND INLAND FISHERIES. W70-00880 05C
FLOOD FORECASTING FREQUENCY ANALYSES OF FLOODS AND DROUGHTS, W70-01120	02E	FRiction COEFFICIENT(HyD) HYDRAULIC PROPERTIES OF SMALL UNLINED ROCK TUNNELS, W70-01115 08B
FLOOD FREQUENCY FREQUENCY ANALYSES OF FLOODS AND DROUGHTS, W70-01120	02E	FROZEN GROUND CERTAIN ASPECTS OF ENGINEERING GEOLOGY IN PERMAFROST, W70-01011 08D
FLOOD PROTECTION EVALUATION OF BENEFITS OF A FLOOD WARNING SYSTEM, W70-00838	06B	Fucus vesiculosus STUDIES ON ALGAL SUBSTANCES IN THE SEA. II. THE FORMATION OF GELBSTOFF (HUMIC MATERIAL) BY EXUDATES OF PHAEOPHYTA, W70-01072 05B
FLOODS FLOOD PLAIN INFORMATION, TROUT AND BIJOU CREEKS, SOUTH LAKE TAHOE, CALIFORNIA. W70-00856	04A	GAME FISH FISH LAWS. W70-01167 06E
THE LAKE MISSOURI FLOODS AND THE CHANNELLED SCABLAND, W70-01012	02J	GAMMA RAYS ESTIMATION OF CLAY CONTENT OF SAND FORMATIONS FROM WELL-LOGGING DATA (RUSSIAN), W70-00877 07B
Frequency ANALYSES OF FLOODS AND DROUGHTS. W70-01120	02E	GARBAGE GRINDERS EXPERIENCE WITH GRINDING AND PUMPING OF SEWAGE FROM BUILDINGS, W70-01056 08C
SHEETFLOODS, STREAMFLOODS, AND THE FORMATION OF PEDIMENTS, W70-01211	02J	GAS CHROMATOGRAPHY APPLICATION OF PYROLYtic GAS CHROMATOGRAPHY TO NATURAL WATERS, W70-00847 05A
FLORIDA BRYANT V PEPE (ESTOPPEL TO ASSERT TITLE WHEN LAND CHANGED BY AVULSION). W70-00972	06E	STATISTICAL CHARACTERIZATION OF MIXTURES OF HYDROCARBONS, W70-01025 05A
SILVER BLUE LAKES APARTMENTS V SILVER BLUE LAKE HOME OWNERS ASS'N INC (UNREASONABLE USE OF ARTIFICIAL WATERBODY). W70-01154	04A	GELBSTOFF STUDIES ON ALGAL SUBSTANCES IN THE SEA. II. THE FORMATION OF GELBSTOFF (HUMIC MATERIAL) BY EXUDATES OF PHAEOPHYTA, W70-01072 05B
FLOW NON-LINEAR FREE SURFACES IN OPEN CHANNELS (FRENCH), W70-00871	08B	STUDIES ON ALGAL SUBSTANCES IN THE SEA. I. GELBSTOFF
FLOW AROUND OBJECTS TURBULENT FRICTION IN ECCENTRIC ANNULAR CONDUITS. W70-01046	08B	
FLOW AUGMENTATION APPROACH TO DETERMINE THE MINIMUM ALLOWABLE FLOW IN THE TISZA RIVER, HUNGARY. W70-01035	05G	
FLOW CONTROL CONTROL TECHNIQUES FOR PRESSURIZED SEWERAGE SYSTEMS,		

(HUMIC MATERIAL) IN TERRESTRIAL AND MARINE WATERS, W70-01074	05B	PATTERNS OF WATER USE IN THE ARIZONA ECONOMY, W70-01202	06D
GEOCHEMISTRY DISTINGUISHING MARINE AND FRESHWATER MUDS, W70-00994	02K	GROUNDWATER BASINS ON THE HYDROGEOLOGY OF THE CENTRAL AND NORTHWESTERN PART OF THE DNEIPER-DONETS ARTESIAN BASIN (UKRAINIAN), W70-00866	02K
GEOLOGY GEOLOGY, PETROLEUM DEVELOPMENT, AND SEISMICITY OF THE SANTA BARBARA CHANNEL REGION, CALIFORNIA, W70-00836	05B	GROUNDWATER MANAGEMENT GENERAL SYSTEMS APPROACH TO GROUND-WATER PROBLEMS, W70-01123	02F
GEOMORPHOLOGY GLACIAL HISTORY AND MORPHOLOGY OF WEST SWEDEN (SWEDISH), W70-00998	02C	GROUNDWATER MINING VALIDATION OF A GROUNDWATER SUPPLY FOR MANAGEMENT AND DEVELOPMENT, W70-00904	04B
THE LAKE MISSOULA FLOODS AND THE CHANNELLED SCABLAND, W70-01012	02J	GROUNDWATER MOVEMENT GROUNDWATER MOVEMENT TOWARD ARTIFICIAL CUTS, W70-00858	02F
THE ANALYSIS AND CLASSIFICATION OF SLOPE PROFILE FORMS, W70-01040	02J	MOVEMENT OF DDT AND NITRATES DURING GROUND-WATER RECHARGE, W70-00861	05B
SHEETFLOODS, STREAMFLOODS, AND THE FORMATION OF PEDIMENTS, W70-01211	02J	TIME VARIANT GROUND WATER FLOW BY RESISTANCE NETWORK ANALOGUES, W70-01039	02F
GEOPHYSICS ON A SOIL AND GROUND WATER INVESTIGATION WITH THE SHALLOW REFRACTION METHOD AT MO I RANA, W70-00995	07B	GROWTH(ECONOMIC) THE ECONOMICS OF ARIZONA'S WATER PROBLEM, W70-01200	06D
GLACIATION GLACIAL HISTORY AND MORPHOLOGY OF WEST SWEDEN (SWEDISH), W70-00998	02C	GULF OF MEXICO SEA FOODS. W70-00967	06E
GLACIERS GLACIAL HISTORY AND MORPHOLOGY OF WEST SWEDEN (SWEDISH), W70-00998	02C	HANGERS TURBULENT FRICTION IN ECCENTRIC ANNULAR CONDUITS, W70-01046	08B
GLOECAPS A NITROGEN FIXATION BY GLOECAPS A, W70-01070	05C	HARBORS DUTIES OF DIRECTOR OF PUBLIC WORKS. W70-01182	04A
GOVERNMENTS THE CONSTITUTIONAL ASPECTS OF WATER POLLUTION AND THE NEED FOR GOVERNMENTAL COOPERATION, W70-00915	05G	CONSTRUCTION OF PORT FACILITIES. W70-01183	04A
GRASSLANDS EFFECTS OF CULTIVATION AND GRASS ON SURFACE RUNOFF, W70-00863	04A	HEAD LOSS TURBULENT FRICTION IN ECCENTRIC ANNULAR CONDUITS, W70-01046	08B
GRAVELS WATER-RETENTION CHARACTERISTICS OF COARSE ROCK PARTICLES, W70-00997	02G	HEAD LOSSES CAUSED BY AN ICE COVER ON OPEN CHANNELS, W70-01126	08B
GRAVIMETRIC ANALYSIS USE OF MEMBRANE FILTERS IN GRAVIMETRIC ANALYSES OF PARTICULATE MATTER IN NATURAL WATERS, W70-00857	07B	HERBICIDES IMPLICATION OF WATER QUALITY AND SALINITY IN THE SURVIVAL OF FRASER RIVER SOCKEYE SMOLTS, W70-01225	05C
GRAZING THE LAND AND WATER USE SURVEY OF NORTH-CENTRAL KORDOFAN (1961-66), W70-01198	03B	HIGHWAYS STATE HIGHWAYS. W70-00888	04A
ESTIMATION OF GRAZING CAPACITY ON ARID GRAZING LANDS, W70-01206	03P	HOLLAND THE INFLUENCE OF SUSPENDED SOLIDS ON THE RATE OF OXYGEN TRANSFER IN AQUEOUS SOLUTIONS, W70-01023	05D
GREAT LAKES TOTAL ALBEDO OF GREAT LAKES ICE, W70-00851	02C	HORTICULTURAL CROPS COMMUNITY IRRIGATION PROJECTS IN THE WAIKERIE DISTRICT OF SOUTH AUSTRALIA, W70-01207	03F
A STOCHASTIC APPROACH TO THE DEVELOPMENT OF A REGULATION PLAN FOR THE GREAT LAKES, W70-00902	02H	HOT WIRE ANEMOMETER A STUDY OF HOT WIRE AND HOT FILM ANEMOMETERS IN WATER (FRENCH), W70-00868	07B
GRINDING ADVANCED DEVELOPMENT OF HOUSEHOLD PUMP-STORAGE-GRINDER UNIT (TASK 6), W70-01048	08C	HOT-FILEM ANEMOMETERS A STUDY OF HOT WIRE AND HOT FILM ANEMOMETERS IN WATER (FRENCH), W70-00868	07B
GROUNDWATER A SCHEME OF GEOTHERMAL WATERS OF CENTRAL ASIA (RUSSIAN), W70-00869	02F	HUMAN ACTIVITIES CITY AIR - BETTER OR WORSE, W70-01239	05B
ROLE OF PROGNOSIS OF GROUNDWATER STATE IN PROJECTION OF DAMS (POLISH), W70-00874	08A	HUMIC ACIDS STUDIES ON ALGAL SUBSTANCES IN THE SEA. II. THE FORMATION OF GELBSTOFF (HUMIC MATERIAL) BY EXUDATES OF PHAEOPHYTA, W70-01072	05B
BASIC CONCEPTS IN GROUND WATER LAW, W70-00914	04B	STUDIES ON ALGAL SUBSTANCES IN THE SEA. I. GELBSTOFF (HUMIC MATERIAL) IN TERRESTRIAL AND MARINE WATERS, W70-01074	05B
GROUNDWATER IN SANTA BARBARA COUNTY, CALIFORNIA, SPRING 1967 TO SPRING 1968, W70-00989	07C	HUMIDITY STATISTICAL STRUCTURE OF VERTICAL HUMIDITY PROFILES (RUSSIAN), W70-01016	02B
ON A SOIL AND GROUND WATER INVESTIGATION WITH THE SHALLOW REFRACTION METHOD AT MO I RANA, W70-00995	07B	HUNGARY THE DYNAMICS OF QUATERNARY SLOPE EVOLUTION AND ITS GEOMORPHOLOGICAL REPRESENTATION, W70-01041	02J
AN INEXPENSIVE SHALLOW WATER TABLE PROBE, W70-00996	07B	HURRICANES NATURAL FEATURES CAUSED BY A CATASTROPHIC STORM IN NELSON AND AMHERST COUNTIES, VIRGINIA., W70-00992	02E
A GROUNDWATER QUALITY SUMMARY FOR ALASKA, W70-01087	04B		
GENERAL SYSTEMS APPROACH TO GROUND-WATER PROBLEMS, W70-01123	02F		
BASIC WATER USE DOCTRINES AND STATE WATER CONTROL AGENCIES. W70-01131	04A		

HYD-INT

SUBJECT INDEX

HYDRAULIC DESIGN HYDRAULIC DESIGN OF UNLINED ROCK TUNNELS, W70-01114	08E	W70-01121 IMPOUNDED WATER SURFACE RUNOFF AND FLOODWATER DIVERSION. W70-01177	08D 04A
HYDRAULIC DIAMETER ON THE CONCEPT OF MEAN HYDRAULIC RADIUS, W70-01117	08B	IMPOUNDMENTS LIMNOLOGICAL EFFECTS OF ORGANIC EXTRACTS OF LITTER IN A SOUTHWESTERN IMPOUNDMENT. W70-01080	02B
HYDRAULIC MODELS SPILLWAY FOR BEND LAKE RESERVOIR, BIG MUDDY RIVER, ILLINOIS HYDRAULIC MODEL INVESTIGATION, W70-01223	08B	INDIANA FISH AND GAME (LICENSES). W70-00943	06E
HYDRAULIC PROPERTIES HYDRAULIC PROPERTIES OF SMALL UNLINED ROCK TUNNELS, W70-01115	08B	FISH (SEASONS, LIMITS, SPAWNING GROUNDS). W70-00944	06E
HYDRAULIC RADIUS ON THE CONCEPT OF MEAN HYDRAULIC RADIUS, W70-01117	08B	COMMERCIAL FISHING DEVICES - REGULATIONS. W70-00946	06E
HYDRAULIC TURBINES INCRAFASING THE CAVITATION RESISTANCE OF PARTS BY USING EXPLOSIVE-WELDED FACINGS, W70-01127	08C	JURISDICTION OF COUNTY DRAINAGE BOARDS. W70-01150	04A
HYDROELECTRIC POWER WATER-POWER DEVELOPMENT, CONSERVATION OF HYDROELECTRIC POWER DAMS AND WORKS. W70-01175	06E	INDUSTRIAL WASTES THE USE OF THE FUNDAMENTAL STUDIES OF BIOLOGICAL PURIFICATION ON THE PURIFICATION OF POLLUTED WATERS DERIVED FROM PRODUCTION OF "KHEZLON" (SLOVAKIAN), W70-00879	05D
RIGHT OF EMINENT DOMAIN OF PUBLIC SERVICE CORPORATIONS. W70-01176	06E	INDUSTRIAL WATER THE USE OF THE FUNDAMENTAL STUDIES OF BIOLOGICAL PURIFICATION ON THE PURIFICATION OF POLLUTED WATERS DERIVED FROM PRODUCTION OF "KHEZLON" (SLOVAKIAN), W70-00879	05D
HYDROELECTRIC PROJECT LICENSING WATER-POWER DEVELOPMENT, CONSERVATION OF HYDROELECTRIC POWER DAMS AND WORKS. W70-01175	06E	WATER QUALITY AND REGIONAL ECONOMY, A DECISION MODEL, W70-00897	05G
HYDROGEOLOGY ON THE HYDROGEOLOGY OF THE CENTRAL AND NORTHWESTERN PART OF THE DNEPER-DONETS ARTESIAN BASIN (UKRAINIAN), W70-00866	02K	INFILTRATION A NUMERIC METHOD FOR ESTIMATING INFILTRATION, REDISTRIBUTION, DRAINAGE, AND EVAPORATION OF WATER FROM SOIL, W70-00862	02G
ON THE PRESENT OPTIMUM VARIANT IN HYDROGEOLOGICAL EXPLORATION (GERMAN), W70-01022	07C	TEMPORAL, HORIZONTAL AND VERTICAL VARIABILITY OF WATER CHEMISTRY IN UNSATURATED ZONE OF FINE-GRAINED SOILS, W70-00911	05B
HYDROLOGIC DATA RECORDS OF SELECTED WELLS AND SPRINGS IN THE RULISON PROJECT AREA, GARFIELD AND MESA COUNTIES, COLORADO, W70-00987	07C	WATER-RETENTION CHARACTERISTICS OF COARSE ROCK PARTICLES, W70-C0997	02G
GROUNDWATER IN SANTA BARBARA COUNTY, CALIFORNIA, SPRING 1967 TO SPRING 1968, W70-00989	07C	INFRARED DETECTORS SURFACE AND SUBSURFACE EXPLORATION BY INFRARED SURVEYS, W70-01128	07B
HYDROLOGIC MODELS SUBSURFACE FLOW REGIMES OF A HYDROLOGIC WATERSHED MODEL, W70-01237	02F	INFRARED PHOTOGRAPHY MULTISENSOR ANALYSIS FOR SOILS MAPPING, W70-01125	07B
HYDROLOGY ANNOTATED BIBLIOGRAPHY ON HYDROLOGY AND SEDIMENTATION, 1963- 65, UNITED STATES AND CANADA. W70-00837	02J	SURFACE AND SUBSURFACE EXPLORATION BY INFRARED SURVEYS, W70-01128	07B
HYDROPONICS TRICKLE IRRIGATION -- A PROMISING SECOND TOOL FOR A BREAKTHROUGH IN FOOD PRODUCTION IN TROPICAL, SUBTROPICAL AND DESERT AREAS, W70-01218	03F	INFRARED RADIATION SURFACE AND SUBSURFACE EXPLORATION BY INFRARED SURVEYS, W70-01128	07B
HYDROXY-INTERLAYER FORMATION FORMATION OF HYDROXY-AL AND -FE INTERLAYERS IN MONTMORILLONITE AND VERMICULITE INFLUENCE OF PARTICLE SIZE AND TEMPERATURE, W70-01014	02K	INFRARED RAYS SURFACE AND SUBSURFACE EXPLORATION BY INFRARED SURVEYS, W70-01128	07B
ICE COVER HEAD LOSSES CAUSED BY AN ICE COVER ON OPEN CHANNELS, W70-01126	08B	INJECTION WELLS OIL FIELDS YIELD NEW DEEP-WELL DISPOSAL TECHNIQUE, W70-00990	05E
ICECAP WASTEWATER DISPOSAL AND MICROBIAL ACTIVITY AT ICE-CAP FACILITIES, W70-00882	05C	INLAND WATERS FISH LAWS, W70-01167	06E
IDAHO A LIMNOLOGICAL COMPARISON OF TWO SMALL IDAHO RESERVOIRS, W70-01005	02H	INPUT-OUTPUT ANALYSIS WATER QUALITY AND REGIONAL ECONOMY, A DECISION MODEL, W70-00897	05G
ILLINOIS STATE HIGHWAYS. W70-00888	04A	INSECTICIDES PERSISTENCE OF DIAZINON AND ZINOPHOS IN SOIL EFFECTS OF AUTOCLOAVING, TEMPERATURE, MOISTURE, AND ACIDITY, W70-01079	02K
CANALS AND WATERWAYS (UPPER MISSISSIPPI RIVERWAY COMPACT). W70-00939	06B	FISHERY MANAGEMENT WITH THE HELP OF THE ORGANOPHOSPHORUS INSECTICIDE, THIOPROTON, W70-01232	05C
DRAINAGE (CHICAGO SANITARY DISTRICT). W70-00940	04A	INSTALLATION COSTS ADVANCED DEVELOPMENT OF HOUSEHOLD PUMP-STORAGE-GRINDER UNIT (TASK 6), W70-01048	08C
DRAINAGE-SELECTION, QUALIFICATIONS, POWERS, AND DUTIES OF COMMISSIONERS AND OTHER OFFICERS. W70-00941	04A	INSTREAM AERATION OXYGEN MANAGEMENT AND ARTIFICIAL REAERATION IN THE AREA OF BALDENET LAKE AND THE LOWER RUHR RIVER (IN GERMAN), W70-01224	05G
FISH (LICENSES AND PERMITS). W70-01148	06E	INSTRUMENTATION A STUDY OF HOT WIRE AND HOT FILM ANEMOMETERS IN WATER (FRENCH), W70-00868	07B
IMPERVIOUS MEMBRANES DECKED ROCKFILL DAMS.		AN INEXPENSIVE SHALLOW WATER TABLE PROBE, W70-00996	07B

INTAKES

SUBJECT	INDEX	INT-LAN
CHARACTERISTIC PRESSURE DISTRIBUTION IN OUTLET WORKS INLETS, W70-01222	08B	
INTERCONNECTED SYSTEMS IMPROVED DIGITAL SIMULATION FOR ANALYZING POWER SYSTEM DISTURBANCES, W70-01105	08C	
INTERSTATE COMMISSIONS CANALS AND WATERWAYS (UPPER MISSISSIPPI RIVERWAY COMPACT), W70-00939	06B	
TOMBIGBEE - TENNESSEE WATERWAY DEVELOPMENT COMPACT. W70-00945	06B	
INTERSTATE COMMISSION ON THE POTOMAC RIVER BASIN. W70-01173	05G	
OHIO RIVER VALLEY WATER SANITATION COMMISSION. W70-01174	05G	
INTERSTATE COMPACTS CANALS AND WATERWAYS (UPPER MISSISSIPPI RIVERWAY COMPACT), W70-00939	06B	
TOMBIGBEE - TENNESSEE WATERWAY DEVELOPMENT COMPACT. W70-00945	06B	
COMMERCIAL FISHING DEVICES - REGULATIONS. W70-00946	06E	
FISHING IN INTERSTATE NONTIDAL WATERS. W70-01020	06E	
INTERSTATE COMMISSION ON THE POTOMAC RIVER BASIN. W70-01173	05G	
OHIO RIVER VALLEY WATER SANITATION COMMISSION. W70-01174	05G	
NEW ENGLAND INTERSTATE WATER POLLUTION CONTROL COMMISSION. W70-01191	05G	
INTERSTATE RIVERS TOMBIGBEE - TENNESSEE WATERWAY DEVELOPMENT COMPACT. W70-00945	06B	
INTERSTATE WATERS FISHING IN INTERSTATE NONTIDAL WATERS. W70-01020	06E	
NEW ENGLAND INTERSTATE WATER POLLUTION CONTROL COMMISSION. W70-01191	05G	
INTERVIEWS NON-MECHANICAL CONSIDERATIONS INVOLVED IN IMPLEMENTING PRESSURIZED SEWERAGE SYSTEMS, W70-01065	08A	
ION ADSORPTION THE RELATION OF ION MOVEMENT TO FINE PARTICLE DISPLACEMENT IN A SAND BED. W70-00909	05B	
ION MOVEMENT THE RELATION OF ION MOVEMENT TO FINE PARTICLE DISPLACEMENT IN A SAND BED, W70-00909	05B	
ION TRANSPORT THE RELATION OF ION MOVEMENT TO FINE PARTICLE DISPLACEMENT IN A SAND BED, W70-00909	05B	
TEMPORAL, HORIZONTAL AND VERTICAL VARIABILITY OF WATER CHEMISTRY IN UMSATURATED ZONE OF FINE-GRAINED SOILS, W70-00911	05B	
IOWA HAS RECENT LEGISLATION LIMITED PRIVATE RIPARIAN RIGHTS IN IOWA, W70-01133	03D	
STOUDER v DASHNER (DOMINANT VERSUS SERVIENT LAND RIGHTS RELATING TO DRAINAGE OF SURFACE WATERS). W70-01146	04A	
IRON FORMATION OF HYDROXY-AL AND -FE INTERLAYERS IN MONTMORILLONITE AND VERMICULITE INFLUENCE OF PARTICLE SIZE AND TEMPERATURE, W70-01014	02K	
IRRIGATED LAND THE DEVELOPMENT OF THE IRRIGATION ECONOMY OF MENDOZA, ARGENTINA, W70-01213	03F	
IRRIGATION NOTES ON WATER WORKS LAW SECOND INSTALLMENT - IRRIGATION AND RIPARIAN RIGHTS, W70-00920	06B	
WATER SUPPLIES IN SOUTH AUSTRALIA, W70-01204	03B	
IRRIGATION OPERATION AND MAINTENANCE NEW WATER BIRD FOR EGYPT A ROBOT SHADDOOF, W70-01205	03F	
IRRIGATION PRACTICES		
TRICKLE IRRIGATION -- A PROMISING SECOND TOOL FOR A BREAKTHROUGH IN FOOD PRODUCTION IN TROPICAL, SUBTROPICAL AND DESERT AREAS, W70-01218	03F	
IRRIGATION PROGRAMS AQUEDUCT ROUTE OPTIMIZATION BY DYNAMIC PROGRAMMING, W70-00894	04A	
THE KHASHM EL GIRBA IRRIGATION SCHEME A NEW SOCIO-ECONOMIC PROJECT IN THE SUDAN, W70-01208	03F	
REGIONAL AND SEASONAL WATER SUPPLY IN THE TARIM BASIN AND ITS RELATION TO CULTIVATED LAND POTENTIALS, W70-01210	03F	
THE WATER PROBLEM IN THE DESERTS OF THE USSR, W70-01215	03B	
IRRIGATION SYSTEM DESIGN A PHYSICAL AND ECONOMIC ANALYSIS OF ALTERNATIVE IRRIGATION METHODS IN A SUB-HUMID CLIMATE, W70-01086	03F	
IRRIGATION SYSTEMS TRICKLE IRRIGATION -- A PROMISING SECOND TOOL FOR A BREAKTHROUGH IN FOOD PRODUCTION IN TROPICAL, SUBTROPICAL AND DESERT AREAS, W70-01218	03F	
JUDICIAL DECISIONS FEDERAL REGULATION OF WATERWAYS, W70-00928	04A	
SILVER BLUE LAKES APARTMENTS v SILVER BLUE LAKE HOME OWNERS ASS'N INC (UNREASONABLE USE OF ARTIFICIAL WATERBODY). W70-01154	04A	
JURISDICTION JURISDICTION OF COUNTY DRAINAGE BOARDS, W70-01150	04A	
KENTUCKY CONDAMNATION BY CITIES, COUNTIES, AND DISTRICTS FOR FLOOD CONTROL OR DRAINAGE, W70-00895	06E	
OFFENSES AGAINST PROPERTY BY FORCE. W70-01149	06E	
KORDOFAN THE LAND AND WATER USE SURVEY OF NORTH-CENTRAL KORDOFAN (1961-66), W70-01198	03B	
KUWAIT CRUDE RECOVERY OF A SALT MARSH IN PEMBROKESHIRE, SOUTH-WEST WALES, FROM POLLUTION BY CRUDE OIL, W70-01231	05C	
LABORATORY TESTS SAMPLING AND ANALYSIS OF WASTE WATER FROM INDIVIDUAL HOMES (TASK 2), W70-01050	08B	
LAKE CONSTANCE DIAGENETIC CHANGES IN INTERSTITIAL WATERS OF HOLOCENE LAKE CONSTANCE SEDIMENTS, W70-01009	02H	
LAKE ICE TOTAL ALBEDO OF GREAT LAKES ICE, W70-00851	02C	
WATER TEMPERATURE DURING THE MELTING OF LAKE ICE, W70-00852	02H	
LAKE MANAGEMENT PROGRAMS THE DILEMMA OF WATER RECREATION AND A SUGGESTED SOLUTION, W70-00930	06D	
LAKE MICHIGAN DRAINAGE (CHICAGO SANITARY DISTRICT). W70-00940	04A	
LAKES NEW THERMAL INVESTIGATION OF LAKES TRAUHSEE AND FUSCHLSEE (IN GERMAN), W70-00886	02H	
THE DILEMMA OF WATER RECREATION AND A SUGGESTED SOLUTION, W70-00930	06D	
THE DILEMMA OF WATER RECREATION AND A SUGGESTED SOLUTION (PART I), W70-00931	06D	
THE DILEMMA OF WATER RECREATION AND A SUGGESTED SOLUTION (PART II), W70-00932	06D	
DIAGENETIC CHANGES IN INTERSTITIAL WATERS OF HOLOCENE LAKE CONSTANCE SEDIMENTS, W70-01009	02H	
SILVER BLUE LAKES APARTMENTS v SILVER BLUE LAKE HOME OWNERS ASS'N INC (UNREASONABLE USE OF ARTIFICIAL WATERBODY). W70-01154	04A	
LAND CLASSIFICATION		

		SUBJECT INDEX
LAND-MAS		
ESTIMATION OF GRAZING CAPACITY ON ARID GRAZING LANDS, W70-01206	03F	WATER AND WATER COURSES--SERVITUDES--ARTICLE 660, LOUISIANA CIVIL CODE OF 1870. W70-00929
LAND MANAGEMENT EFFECTS OF CULTIVATION AND GRASS ON SURFACE RUNOFF, W70-00863	04A	04A CIVIL LAW PROPERTY--ENCROACHMENTS ON RIVER BANKS BY RIPARIAN OWNERS. W70-01135
LAND RECLAMATION THE ASWAN HIGH DAM, W70-01201	06B	04C LOW-FLOW AUGMENTATION REGIONAL AND SEASONAL WATER SUPPLY IN THE TARIM BASIN AND ITS RELATION TO CULTIVATED LAND POTENTIALS. W70-01210
LAND RESOURCES CHALLENGES TO CREATIVE CONSERVATION, W70-01081	06G	LYSIMETERS SEASONAL VARIATION IN RAIN GAGE CATCH. W70-00854
LAND TENURE CIVIL LAW PROPERTY--ENCROACHMENTS ON RIVER BANKS BY RIPARIAN OWNERS, W70-01135	04C	Maintenance LONG-TERM OPERATION OF WASTEWATER OBSERVATION STATIONS (TASK 2), W70-01049
THE DEVELOPMENT OF THE IRRIGATION ECONOMY OF MENDOZA, ARGENTINA, W70-01213	03F	08B EXPERIENCE WITH GRINDING AND PUMPING OF SEWAGE FROM BUILDINGS, W70-01056
LATVIA STRONTIUM-90 CONCENTRATION FACTORS OF LAKE PLANKTON, MACROPHYTES, AND SUBSTRATES, W70-01010	05C	MANUFACTURING INCREASING THE CAVITATION RESISTANCE OF PARTS BY USING EXPLOSIVE-WELDED FACINGS. W70-01127
LEGAL ASPECTS PRIVATE WATER RIGHTS IN FRANCE AND IN THE EASTERN UNITED STATES, W70-00916	06B	MAN-MADE LAKES SILVER BLUE LAKES APARTMENTS V SILVER BLUE LAKE HOME OWNERS ASS'N INC (UNREASONABLE USE OF ARTIFICIAL WATERBODY). W70-01154
NOTES ON WATER WORKS LAW SECOND INSTALLMENT - IRRIGATION AND RIPARIAN RIGHTS, W70-00920	06B	04A MAPPING ON THE PRESENT OPTIMUM VARIANT IN HYDROGEOLOGICAL EXPLORATION (GERMAN). W70-01022
NON-MECHANICAL CONSIDERATIONS INVOLVED IN IMPLEMENTING PRESSURIZED SEWERAGE SYSTEMS, W70-01065	08A	07C MARINE ALGAE STUDIES ON ALGAL SUBSTANCES IN THE SEA. II. THE FORMATION OF GELBSTOFF (HUMIC MATERIAL) BY EXUDATES OF PHAEOPHYTA, W70-01072
SILVER BLUE LAKES APARTMENTS V SILVER BLUE LAKE HOME OWNERS ASS'N INC (UNREASONABLE USE OF ARTIFICIAL WATERBODY). W70-01154	04A	05B STUDIES ON ALGAL SUBSTANCES IN THE SEA. III. THE PRODUCTION OF EXTRACELLULAR ORGANIC MATTER BY LITTORAL MARINE ALGAE, W70-01073
LEGISLATION BASIC CONCEPTS IN GROUND WATER LAW, W70-00914	04B	05B STUDIES ON ALGAL SUBSTANCES IN THE SEA. I. GELBSTOFF (HUMIC MATERIAL) IN TERRESTRIAL AND MARINE WATERS, W70-01074
WATER AND WATER COURSES--SERVITUDES--ARTICLE 660, LOUISIANA CIVIL CODE OF 1870. W70-00929	04A	05C MARINE BIRDS OIL POLLUTION OF THE SEA IS THE END IN SIGHT, W70-01230
LEONTIEF MODELS WATER QUALITY AND REGIONAL ECONOMY, A DECISION MODEL, W70-00897	05G	05C MARINE FAUNA OIL POLLUTION OF THE SEA IS THE END IN SIGHT, W70-01230
LIMNOLOGY A LIMNOLOGICAL COMPARISON OF TWO SMALL IDAHO RESERVOIRS, W70-01005	02H	06E MARINE FISH SEA FOODS. W70-00967
SEASONAL CHARACTERISTICS OF TWO SALINE LAKES IN WASHINGTON, W70-01076	02H	05A MARINE FISH POISONING A RAPID FOR MEASURING THE ACUTE TOXICITY OF DISSOLVED MATERIALS TO MARINE FISHES. W70-00849
SOME LIMNOLOGICAL FEATURES OF A SHALLOW SALINE MEROMICTIC LAKE, W70-01077	02H	05E MARINE FISHERIES MARINE RESOURCES COMMISSION. W70-01162
LIMNOLOGICAL EFFECTS OF ORGANIC EXTRACTS OF LITTER IN A SOUTHWESTERN IMPOUNDMENT, W70-01080	02H	05C MARINE MICROORGANISMS THE INFLUENCE OF ALGAL ANTIBIOSIS ON THE ECOLOGY OF MARINE MICROORGANISMS. W70-01068
LINEAR PROGRAMMING OPTIMIZATION OF THE LONG-TERM OPERATION OF A SINGLE-PURPOSE RESERVOIR, W70-00901	03B	02K MARINE MUD-FRESH MUD DIFFERENCES DISTINGUISHING MARINE AND FRESHWATER MUDS, W70-00994
LINEAR PROGRAMMING FOR HYDROLOGIC ANALYSES, W70-00999	02A	06E MARINE RESOURCES THE TAKING OF MINERALS FROM BEDS AND NAVIGATION. W70-00983
STOCHASTIC METHODS FOR ANALYZING RIVER BASIN SYSTEMS, W70-01085	06A	03E MARINE RESOURCES COMMISSION. W70-01162
LITTORAL STUDIES ON ALGAL SUBSTANCES IN THE SEA. III. THE PRODUCTION OF EXTRACELLULAR ORGANIC MATTER BY LITTORAL MARINE ALGAE, W70-01073	05B	03E OWNERSHIP OF BEDS. W70-01168
LOCAL GOVERNMENTS CONDAMNATION BY CITIES AND COUNTIES TO PROVIDE WATERSHEDS OR BEDS FOR WATER PIPES. W70-00973	04A	06E MARINE SURVIVAL IMPLICATION OF WATER QUALITY AND SALINITY IN THE SURVIVAL OF FRASER RIVER SOCKEYE SMOLTS. W70-01225
CONSTRUCTION, OPERATION, AND MAINTENANCE OF TOLL BRIDGES OVER PEARL RIVER. W70-01152	06E	05C MARKOV PROCESSES OPTIMIZATION OF THE LONG-TERM OPERATION OF A SINGLE-PURPOSE RESERVOIR, W70-00901
FLOOD CONTROL. W70-01153	04A	03B MARSH PLANTS RECOVERY OF A SALT MARSH IN PEMBROKESHIRE, SOUTH-WEST WALES, FROM POLLUTION BY CRUDE OIL, W70-01231
FEDERAL WATER RESOURCES DEVELOPMENT. W70-01179	06B	05C MASSACHUSETTS
LONG-TERM PLANNING OPTIMIZATION OF THE LONG-TERM OPERATION OF A SINGLE-PURPOSE RESERVOIR, W70-00901	03B	
LOUISIANA		

SUBJECT	INDEX	MAS-MIS
COMMENT EXTENDING THE APPLICATION OF THE LAW OF ACCRECTIONS. W70-00921	04A	
RIPARIAN WATER RIGHTS V A PRIOR APPROPRIATION SYSTEM COMPARISON, W70-01139	06B	
BIPARTIAN WATERS RIGHTS V A PRIOR APPROPRIATION SYSTEM COMPARISON, W70-01140	06B	
RIPARIAN WATER RIGHTS V A PRIOR APPROPRIATION SYSTEM COMPARISON, W70-01141	06B	
W70-01142	06B	
MATERIAL TESTING FINAL REPORT TO THE AMERICAN SOCIETY OF CIVIL ENGINEERS ON TASK 7 AND TASK 9 OF THE COMBINED SEWER SEPARATION PROJECT, W70-01043	08A	
MATHEMATICAL MODELS A MODEL FOR RAINFALL ROUTING DURING INITIAL ABSTRACTION, W70-00844	02A	
EFFECT OF RAINFALL VARIABILITY ON STREAMFLOW SIMULATION, W70-00850	02A	
CONTINUOUS HYDROGRAPH SYNTHESIS WITH AN API-TYPE HYDROLOGIC MODEL, W70-00860	02A	
PHYSICAL MODELING OF REGIME OF BODIES OF WATER TO STUDY THEIR SANITATION CONDITION (IN RUSSIAN), W70-00885	05B	
CATAST SYSTEM CONTROLS FOR REGULATION OF COMBINED SEWAGE FLOWS, W70-00889	05D	
ANALYSIS AND OPTIMIZATION OF A REVERSE OSMOSIS PURIFICATION SYSTEM--PART II. OPTIMIZATION, W70-00890	03A	
EXPERIMENTAL STUDY OF SLURRY SEPARATORS FOR USE IN DEASALINATION, W70-00892	03A	
OPTIMIZATION OF THE ACTIVATED SLUDGE PROCESS-OPTIMUM VOLUME RATIO OF AERATION AND SEDIMENTATION VESSELS, W70-00893	05D	
MATHEMATICAL SIMULATION OF THE ESTUARINE BEHAVIOR AND ITS APPLICATIONS, W70-00896	05C	
DYNAMIC ASPECTS OF URBAN WATER DEMAND, W70-00899	06D	
VALUATION OF A GROUNDWATER SUPPLY FOR MANAGEMENT AND DEVELOPMENT, W70-00904	04B	
A WATER YIELD MODEL DERIVED FROM MONTHLY RUNOFF DATA, W70-00905	03B	
THE OPTIMUM TEMPERATURE FOR THE OPERATION OF A NON-SCALING MULTI-STAGE FLASH EVAPORATOR PLANT, W70-00907	03A	
LINEAR PROGRAMMING FOR HYDROLOGIC ANALYSES, W70-00999	02A	
CONSTRUCTION OF A MULTILEVEL SCHEME STABLE IN RELATION TO INITIAL DATA FOR SHORT-RANGE WEATHER FORECAST (RUSSIAN), W70-01015	02B	
STATISTICAL STRUCTURE OF VERTICAL HUMIDITY PROFILES (RUSSIAN), W70-01016	02B	
NONLINEAR THEORY OF WIND DRIFT OF ICE (RUSSIAN), W70-01018	02C	
THE PREDICTION OF THE DISTRIBUTION OF DISSOLVED OXYGEN IN RIVERS, W70-01033	05B	
GENERAL SYSTEMS APPROACH TO GROUND-WATER PROBLEMS, W70-01123	02F	
MATHEMATICAL STUDIES LINEAR PROGRAMMING FOR HYDROLOGIC ANALYSES, W70-00999	02A	
STORAGE YIELD EXTENDING THE SEQUENT PEAK ALGORITHM TO MULTIPLE RESERVOIRS, W70-01000	06A	
SPATIALLY VARIED FLOW EQUATIONS, W70-01003	02E	
NONLINEAR THEORY OF WIND DRIFT OF ICE (RUSSIAN), W70-01018	02C	
MEASUREMENT AN INEXPENSIVE SHALLOW WATER TABLE PROBE, W70-00996	07B	
REVIEW OF METHODS FOR MEASURING AND PREDICTING SEEPAGE, W70-01238	04A	
MEASURING INSTRUMENTS STRENGTH TEST ON NEWLY FALLEN SNOW, W70-01221	07B	
MECHANICAL PROPERTIES STRENGTH TEST ON NEWLY FALLEN SNOW, W70-01221	07B	
MELT WATER REGIONAL AND SEASONAL WATER SUPPLY IN THE TARIM BASIN AND ITS RELATION TO CULTIVATED LAND POTENTIALS, W70-01210	03F	
MELTING WATER TEMPERATURE DURING THE MELTING OF LAKE ICE, W70-00852	02H	
MEMBRANES DECKED ROCKFILL DAMS, W70-01121	08D	
MEROMIXIS SOME LIMNOLOGICAL FEATURES OF A SHALLOW SALINE MEROMIC TIC LAKE, W70-01077	02R	
MESQUITE NET RADIATION IN A RIPARIAN MESQUITE COMMUNITY, W70-00853	02I	
METAL COATINGS INCREASING THE CAVITATION RESISTANCE OF PARTS BY USING EXPLOSIVE-WELDED FACINGS, W70-01127	08C	
METEOROLOGICAL DATA WEATHER PATTERNS IN SOUTHERN WEST PAKISTAN, W70-01197	02B	
METEOROLOGY WEATHER PATTERNS IN SOUTHERN WEST PAKISTAN, W70-01197	02B	
METHODOLOGY STATISTICAL CHARACTERIZATION OF MIXTURES OF HYDROCARBONS, W70-01025	05A	
MIGRATION SEAWARD IMPLICATION OF WATER QUALITY AND SALINITY IN THE SURVIVAL OF FRASER RIVER SOCKEYE SMOLTS, W70-01225	05C	
MILDAMS DAMS, W70-00891	04A	
MILLS MILLS, DAMS, AND CERTAIN OTHER WORKS ON WATERCOURSES, W70-01178	04A	
MINEROLOGY THE TAKING OF MINERALS FROM BEDS AND NAVIGATION, W70-00983	06E	
MINNESOTA WESTPHAL V SCHMALZ (UNAUTHORIZED USE OF DRAINAGE SYSTEM). W70-00971	04A	
MISSISSIPPI LOWER MISSISSIPPI RIVER BASIN DEVELOPMENT DISTRICT. W70-00912	04A	
TOMBIGBEE - TENNESSEE WATERWAY DEVELOPMENT COMPACT. W70-00945	06B	
SALVAGE. W70-00947	06E	
HIGHWAYS, FERRIES, WATERWAYS. W70-00948	06E	
FISH POISONING POISONING WATER SUPPLY. W70-00949	05G	
Navigable Waters - Public Highways. W70-00950	06E	
BRIDGES - BOUNDARY AND OTHER WATERS. W70-00951	06E	
DRAINAGE DISTRICTS. W70-00952	04A	
SWAMP LAND DISTRICTS. W70-00953	04A	
FLOOD CONTROL - DRAINAGE DISTRICTS. W70-00954	04A	
TOMBIGBEE RIVER VALLEY WATER MANAGEMENT DISTRICT. W70-00955	04A	
W70-00956	04A	
W70-00957	04A	
PAT HARRISON WATERWAY DISTRICT. W70-00958	05G	

MIS-NIL

SUBJECT INDEX

W70-00959	05G	MURRAY RIVER COMMUNITY IRRIGATION PROJECTS IN THE WAIKERIE DISTRICT OF SOUTH AUSTRALIA, W70-01207	03F
W70-00960	05G	NAJAS MINOR FACTORS AFFECTING THE GROWTH OF NAJAS IN PICKWICK RESERVOIR, W70-01071	05C
BIG BLACK RIVER BASIN DISTRICT. W70-00961	04A	NAJAS QUADALUPENSIS FACTORS AFFECTING THE GROWTH OF NAJAS IN PICKWICK RESERVOIR, W70-01071	05C
W70-00962	04A	NATURAL FLOW DOCTRINE PRIVATE WATER RIGHTS IN FRANCE AND IN THE EASTERN UNITED STATES, W70-00918	06B
W70-00963	04A	NATURAL RESOURCES CHALLENGES TO CREATIVE CONSERVATION, W70-01081	06G
LOWER YAZOO RIVER BASIN DISTRICT. W70-00964	04A	NAVIGABLE RIVERS FERRIES, W70-00913	04A
W70-00965	04A	IMPROVEMENT OF NAVIGABILITY OF STREAMS, W70-01180	04A
W70-00966	04A	NAVIGABLE WATERS PRIVATE WATER RIGHTS IN FRANCE AND IN THE EASTERN UNITED STATES, W70-00917	06B
SEA FOODS. W70-00967	06E	FEDERAL REGULATION OF WATERWAYS. W70-00928	04A
W70-00968	06E	NAVIGABLE WATERS--ARTIFICIAL LAKE CONNECTED TO RIVER, W70-00937	04A
W70-00969	06E	HIGHWAYS, FERRIES, WATERWAYS, W70-00948	06E
SEA FOODS OYSTERS. W70-00970	06E	NAVIGABLE WATERS - PUBLIC HIGHWAYS. W70-00950	06E
OBSTRUCTION AND POLLUTION OF WATERS. W70-01151	05G	WISCONSIN LAW OF WATERS, W70-01138	04A
CONSTRUCTION, OPERATION, AND MAINTENANCE OF TOLL BRIDGES OVER PEARL RIVER. W70-01152	06E	NAVIGATION NAVIGABLE WATERS - PUBLIC HIGHWAYS. W70-00950	06E
FLOOD CONTROL. W70-01153	04A	THE TAKING OF MINERALS FROM BEDS AND NAVIGATION. W70-00983	06E
WATER RESOURCES. W70-01156	04B	IMPROVEMENT OF NAVIGABILITY OF STREAMS, W70-01180	04A
PEARL RIVER BASIN DEVELOPMENT DISTRICT ACT. W70-01157	06B	OBSTRUCTIONS TO NAVIGATION. W70-01184	04A
W70-01158	06B	STAKES AND BUOYS. W70-01185	06E
PEARL RIVER BASIN DEVELOPMENT ACT. W70-01159	06B	RHODE ISLAND PILOTAGE REGULATION. W70-01186	04A
MISSOURI NAVIGABLE WATERS--ARTIFICIAL LAKE CONNECTED TO RIVER, W70-00937	04A	NETS FISH AND FISHING GENERALLY TROLLS, TRAWL NETS, AND DRAG NETS. W70-00976	06E
MIXING AN ESTIMATION OF WIND EFFECTS ON DISPERSION IN WIDE CHANNELS, W70-00842	02E	NETWORKS MEASURING RAINFALL ON FOREST CATCHMENTS, W70-00843	02B
THE PREDICTION OF THE DISTRIBUTION OF DISSOLVED OXYGEN IN RIVERS, W70-01033	05B	NEVADA AN EMPIRICAL METHOD FOR ESTIMATING MONTHLY POTENTIAL EVAPOTRANSPIRATION IN NEVADA, W70-01004	02D
ABOUT THE QUESTION OF VERTICAL MIXING OF WASTE WATERS IN CLOSED RESERVOIRS (IN RUSSIAN), W70-01078	05B	NEW ENGLAND INTERSTATE WPS COMPACT NEW ENGLAND INTERSTATE WATER POLLUTION CONTROL COMMISSION. W70-01191	05G
MODEL STUDIES SOIL MOVEMENT ON IRREGULAR SLOPES. W70-00864	02J	NEW GUINEA VILLAGE WATER SUPPLY INVESTIGATION, TERRITORY OF PAPUA AND NEW GUINEA, W70-00991	03B
PHYSICAL MODELING OF REGIME OF BODIES OF WATER TO STUDY THEIR SANITATION CONDITION (IN RUSSIAN), W70-00885	05B	NEW JERSEY REAL PROPERTY--RIPARIAN GRANTS--LEGISLATIVE LIMITATIONS ON EXTENT OF GRANT. W70-00927	06B
THE USE OF A DIGITAL SIMULATION SYSTEM FOR THE MODELING AND PREDICTION OF WATER QUALITY, W70-01030	05A	NEW JERSEY TURNPIKE AUTHORITY V SISSLERMAN (CONDAMNATION OF RIPARIAN LAND). W70-01155	06E
TIME VARIANT GROUND WATER FLOW BY RESISTANCE NETWORK ANALOGUES, W70-01039	02F	NEW SOUTH WALES ESTIMATION OF GRAZING CAPACITY ON ARID GRAZING LANDS, W70-01206	03F
MODEL TESTS THE SEISMIC DESIGN STUDY OF A DOUBLE CURVATURE ARCH DAM, W70-01094	08A	NEW YORK ROCKLAND COUNTY ANTI-RESERVOIR ASS'N V DURYEA (PREVENTION OF RESERVOIR CONSTRUCTION). W70-01147	08A
MOISTURE EFFECTS PERSISTENCE OF DIAZINON AND ZINOPHOS IN SOIL EFFECTS OF AUTOCLAVING, TEMPERATURE, MOISTURE, AND ACIDITY, W70-01079	02K	NILE VALLEY	
MONTMORILLONITE FORMATION OF HYDROXY-AL AND -FE INTERLAYERS IN MONTMORILLONITE AND VERMICULITE INFLUENCE OF PARTICLE SIZE AND TEMPERATURE, W70-01014	02K		
MOSQUITO FISH PATTERNS OF INSECTICIDE RESISTANCE IN THE MOSQUITOFISH, GAMBUSIA AFFINIS, W70-01226	05C		
mountain forests nocturnal air temperature on a forested mountain slope, W70-01219	02B		
MUNICIPAL WATER VILLAGE WATER SUPPLY INVESTIGATION, TERRITORY OF PAPUA AND NEW GUINEA, W70-00991	03B		

THE ASWAN HIGH DAM, W70-01201	06B	(HUMIC MATERIAL) IN TERRESTRIAL AND MARINE WATERS, W70-01074	05B
NITRATES MOVEMENT OF DDT AND NITRATES DURING GROUND-WATER RECHARGE, W70-00861	05B	OIL DISCHARGE OIL POLLUTION OF THE SEA IS THE END IN SIGHT, W70-01230	05C
USE OF A SELECTIVE ION ELECTRODE FOR DETERMINATION OF NITRATE IN SOILS, W70-01075	05A	OIL FIELDS GEOLOGY, PETROLEUM DEVELOPMENT, AND SEISMICITY OF THE SANTA BARBARA CHANNEL REGION, CALIFORNIA, W70-00836	05B
NITROGEN COMPOUNDS CAUSES AND CONSEQUENCES OF POND EUTROPHICATION (POLISH), W70-01082	05F	OIL POLLUTION RECOVERY OF A SALT MARSH IN PEMBROKESHIRE, SOUTH-WEST WALES, FROM POLLUTION BY CRUDE OIL, W70-01231	05C
NITROGEN FIXATION NITROGEN FIXATION BY GLOEOMAXXA, W70-01070	05C	OIL POLLUTION MARINE OIL POLLUTION OF THE SEA IS THE END IN SIGHT, W70-01230	05C
MONTIDAL WATERS FISHING IN INTERSTATE MONTIDAL WATERS. W70-01020	06E	OILED MARINE BIRDS OIL POLLUTION OF THE SEA IS THE END IN SIGHT, W70-01230	05C
NON-NAVIGABLE WATERS FERRIES. W70-00913	04A	OILY WATER OIL POLLUTION OF THE SEA IS THE END IN SIGHT, W70-01230	05C
PRIVATE WATER RIGHTS IN FRANCE AND IN THE EASTERN UNITED STATES, W70-00917	06B	RECOVERY OF A SALT MARSH IN PEMBROKESHIRE, SOUTH-WEST WALES, FROM POLLUTION BY CRUDE OIL, W70-01231	05C
CONSTITUTIONAL LAW--COMMERCE CLAUSE--WATER RIGHTS IN THE FLOW OF A NON-NAVIGABLE STREAM ARE PROPERTY RIGHTS, W70-00922	04A	ON-SITE TESTS FLUORESCENT SAND AS A TRACER OF FLUVIAL SEDIMENT, W70-00867	02J
WATER-DRAINAGE AND LEVEE DISTRICTS. W70-00942	04A	FINAL REPORT TO THE AMERICAN SOCIETY OF CIVIL ENGINEERS ON TASK 7 AND TASK 9 OF THE COMBINED SEWER SEPARATION PROJECT, W70-01043	08A
NON-STRUCTURAL ALTERNATIVES EVALUATION OF BENEFITS OF A FLOOD WARNING SYSTEM, W70-00838	06B	PRESSURE TUBING FIELD INVESTIGATION, W70-01058	08A
NORTHEASTERN USSR ON THE POSSIBILITY OF ESTIMATING THE THICKNESS OF UNCONSOLIDATED ROCKS BY VERTICAL ELECTRICAL SOUNDING IN PERMAFROST AREAS (RUSSIAN), W70-00878	07B	ON-SITE-TESTS DEVELOP AND FIELD TEST METHOD OF INSTALLING PRESSURE CONDUITS IN COMBINED SEWERS, W70-01044	08A
NORWAY ON A SOIL AND GROUND WATER INVESTIGATION WITH THE SHALLOW REFRACTION METHOD AT NO I RANA, W70-00995	07B	OPEN CHANNEL FLOW AN ESTIMATION OF WIND EFFECTS ON DISPERSION IN WIDE CHANNELS, W70-00842	02E
NUTRIENT REQUIREMENTS FACTORS AFFECTING THE GROWTH OF MAJAS IN PICKWICK RESERVOIR, W70-01071	05C	NON-LINEAR FREE SURFACES IN OPEN CHANNELS (FRENCH), W70-00871	08B
NUTRIENTS STUDIES ON NATURAL FACTORS AFFECTING PHOSPHATE ABSORPTION AND ITS UTILIZATION BY ALGAE, W70-01031	05C	PROPAGATION OF WAVE-FRONTS IN WIDE CHANNELS OF ARBITRARY CROSS-SECTION, W70-00872	08B
OASES OASES FOR THE FUTURE, W70-01203	06B	HEAD LOSSES CAUSED BY AN ICE COVER ON OPEN CHANNELS, W70-01126	08B
OBSERVATIONAL METHOD ADVANTAGES AND LIMITATIONS OF THE OBSERVATIONAL METHOD IN APPLIED SOIL MECHANICS, W70-01092	08D	OPEN CHANNELS NON-LINEAR FREE SURFACES IN OPEN CHANNELS (FRENCH), W70-00871	08B
OBSTRUCTION TO FLOW WATER AND WATER COURSES--SERVITUDES--ARTICLE 660, LOUISIANA CIVIL CODE OF 1870. W70-00929	04A	HEAD LOSSES CAUSED BY AN ICE COVER ON OPEN CHANNELS, W70-01126	08B
WATER-DRAINAGE AND LEVEE DISTRICTS. W70-00942	04A	OPERATING COSTS ANALYSIS AND OPTIMIZATION OF A REVERSE OSMOSIS PURIFICATION SYSTEM--PART II. OPTIMIZATION, W70-00890	03A
THE TAKING OF MINERALS FROM BEDS AND NAVIGATION. W70-00983	06E	ADVANCED DEVELOPMENT OF HOUSEHOLD PUMP-STORAGE-GRINDER UNIT (TASK 6), W70-01048	08C
STOUDER V DASHNER (DOMINANT VERSUS SERVIENT LAND RIGHTS RELATING TO DRAINAGE OF SURFACE WATERS). W70-01146	04A	OPERATING EXPERIENCE LONG-TERM OPERATION OF WASTEWATER OBSERVATION STATIONS (TASK 2), W70-01049	08B
OBSTRUCTION AND POLLUTION OF WATERS. W70-01151	05G	OPERATIONS EXPERIENCE WITH GRINDING AND PUMPING OF SEWAGE FROM BUILDINGS, W70-01056	08C
OBSTRUCTION TO NAVIGATION OBSTRUCTIONS TO NAVIGATION. W70-01184	04A	OPTIMIZATION ANALYSIS AND OPTIMIZATION OF A REVERSE OSMOSIS PURIFICATION SYSTEM--PART II. OPTIMIZATION, W70-00890	03A
OBSTRUCTIONS TO NAVIGATION HIGHWAYS, FERRIES, WATERWAYS. W70-00948	06E	OPTIMIZATION OF THE ACTIVATED SLUDGE PROCESS--OPTIMUM VOLUME RATIO OF AERATION AND SEDIMENTATION VESSELS, W70-00893	05D
MILLS, DAMS, AND CERTAIN OTHER WORKS ON WATERCOURSES. W70-01178	04A	AQUEDUCT ROUTE OPTIMIZATION BY DYNAMIC PROGRAMMING, W70-00894	04A
OCEANS STUDIES ON ALGAL SUBSTANCES IN THE SEA. II. THE FORMATION OF GELBSTOFF (HUMIC MATERIAL) BY EXUDATES OF PHAEOPHYTA, W70-01072	05B	A SYSTEMS APPROACH TO WASTE MANAGEMENT, W70-00898	05D
STUDIES ON ALGAL SUBSTANCES IN THE SEA. III. THE PRODUCTION OF EXTRACELLULAR ORGANIC MATTER BY LITTORAL MARINE ALGAE, W70-01073	05B	DYNAMIC ASPECTS OF URBAN WATER DEMAND, W70-00899	06D
STUDIES ON ALGAL SUBSTANCES IN THE SEA. I. GELBSTOFF		SIMULATION OF RUNOFF FOR DESIGN OF WATER RESOURCE SYSTEMS, W70-00900	04A

OPT-PER

SUBJECT INDEX

OPTIMIZATION OF THE LONG-TERM OPERATION OF A SINGLE-PURPOSE RESERVOIR, W70-00901	03B	OYSTERS SEA FOODS. W70-00968	06E
A STOCHASTIC APPROACH TO THE DEVELOPMENT OF A REGULATION PLAN FOR THE GREAT LAKES, W70-00902	02H	W70-00969	06E
APPLICATION OF DYNAMIC PROGRAMMING TO THE CONTROL OF WATER RESOURCES SYSTEMS, W70-00903	06A	SEA FOODS OYSTERS. W70-00970	06E
VALUATION OF A GROUNDWATER SUPPLY FOR MANAGEMENT AND DEVELOPMENT, W70-00904	04B	TAKING OYSTERS GENERALLY. W70-00978	06E
A CONJUNCTIVE OPERATION OF A SURFACE RESERVOIR AND A GROUNDWATER AQUIFER, W70-00906	02A	OYSTER RECORDS AND TAXES. W70-00979	06E
THE OPTIMUM TEMPERATURE FOR THE OPERATION OF A NON-SCALING MULTI-STAGE FLASH EVAPORATOR PLANT, W70-00907	03A	CARRYING OYSTERS FROM STATE OR CERTAIN GROUNDS. W70-00980	06E
OPTIMIZATION TECHNIQUES IN WEATHER MODIFICATION, W70-01122	03B	FISH, OYSTERS, SHELLFISH, AND OTHER MARINE LIFE MARINE RESOURCES COMMISSION AND COMMISSIONER OF MARINE RESOURCES. W70-01161	03E
OXYGEN MANAGEMENT AND ARTIFICIAL REAERATION IN THE AREA OF BALDENYE LAKE AND THE LOWER RUHR RIVER (IN GERMAN), W70-01224	05G	SURVEYS OF AND RIGHTS IN OYSTER GROUNDS. W70-01163	03E
OPTIMIZATION TIDAL WATERS MATHEMATICAL SIMULATION OF THE ESTUARINE BEHAVIOR AND ITS APPLICATIONS, W70-00896	05C	LEASING OYSTER-PLANTING GROUNDS. W70-01164	03E
ORGANIC COMPOUNDS APPLICATION OF PYROLYTIC GAS CHROMATOGRAPHY TO NATURAL WATERS, W70-00847	05A	TRANSFER OF OYSTER-PLANTING LEASES RIGHTS OF RIPARIANS. W70-01165	03E
CALCIUM CARBONATE INTERACTION WITH ORGANIC COMPOUNDS, W70-01069	02K	CULLING OYSTERS. W70-01166	03E
ORGANIC MATTER STUDIES ON ALgal SUBSTANCES IN THE SEA. III. THE PRODUCTION OF EXTRACELLULAR ORGANIC MATTER BY LITTORAL MARINE ALGAE, W70-01073	05B	PARTICLE SHAPE MODIFIED RUBEY'S LAW ACCURATELY PREDICTS SEDIMENT SETTLING VELOCITIES. W70-00855	02J
LIMNOLOGICAL EFFECTS OF ORGANIC EXTRACTS OF LITTER IN A SOUTHWESTERN IMPOUNDMENT, W70-01080	02H	PARTICLE SIZE MODIFIED RUBEY'S LAW ACCURATELY PREDICTS SEDIMENT SETTLING VELOCITIES. W70-00855	02J
ORGANOPHOSPHOROUS PESTICIDES PATTERNS OF INSECTICIDE RESISTANCE IN THE MOSQUITOFISH, GAMBUSSIA AFFinis, W70-01226	05C	PASTURE MANAGEMENT ESTIMATION OF GRAZING CAPACITY ON ARID GRAZING LANDS. W70-01206	03F
ORGANOPHOSPHORUS PESTICIDES FISHERY MANAGEMENT WITH THE HELP OF THE ORGANOPHOSPHORUS INSECTICIDE, THIOMETON, W70-01232	05C	PATH OF POLLUTANTS MOVEMENT OF DDT AND NITRATES DURING GROUND-WATER RECHARGE, W70-00861	05B
OUTLET WORKS CHARACTERISTIC PRESSURE DISTRIBUTION IN OUTLET WORKS INLETS, W70-01222	08B	PEAK DEMANDS SEWAGE FLOW VARIATIONS IN INDIVIDUAL HOMES. W70-01055	08B
OVERDRAFT THE ECONOMICS OF ARIZONA'S WATER PROBLEM, W70-01200	06D	DOMESTIC SEWAGE FLOW CRITERIA FOR EVALUATION OF PROJECT SCHEME TO ACTUAL COMBINED SEWER DRAINAGE AREAS, W70-01061	08B
PATTERNS OF WATER USE IN THE ARIZONA ECONOMY, W70-01202	06D	PEAK DISCHARGE PEAK FLOWS OF SEWAGE FROM INDIVIDUAL HOUSES, W70-01062	08B
OVERLAND FLOW SPATIALLY VARIED FLOW EQUATIONS, W70-01003	02E	PEDIMENTS SHEETFLOODS, STREAMFLOODS, AND THE FORMATION OF PEDIMENTS, W70-01211	02J
OWNERSHIP OF BEDS REAL PROPERTY--RIPARIAN GRANTS--LEGISLATIVE LIMITATIONS ON EXTENT OF GRANT. W70-00927	06B	PENNSYLVANIA STATUTORY STREAM POLLUTION-CONTROL, W70-00923	05G
SALVAGE. W70-00947	06E	W70-00924	05G
OWNERSHIP OF BEDS. W70-01168	06E	W70-00925	05G
OXYGEN REQUIREMENTS APPROACH TO DETERMINE THE MINIMUM ALLOWABLE FLOW IN THE TISZA RIVER, HUNGARY. W70-01035	05G	W70-00926	05G
OXYGEN TRANSFER THE INFLUENCE OF SUSPENDED SOLIDS ON THE RATE OF OXYGEN TRANSFER IN AQUEOUS SOLUTIONS, W70-01023	05D	PLISTOCENE ACTIVITY AND HOLOCENE STABILITY OF HILLSLOPES, WITH EXAMPLES FROM SCANDINAVIA AND PENNSYLVANIA, W70-01042	02J
OXYGENATION THE INFLUENCE OF SUSPENDED SOLIDS ON THE RATE OF OXYGEN TRANSFER IN AQUEOUS SOLUTIONS, W70-01023	05D	PERCHED WATER THE STUDY OF LOCAL WATERS IN THE DESERTS OF THE USSR, W70-01216	03B
CAUSES AND CONSEQUENCES OF POND EUTROPHICATION (POLISH), W70-01082	05F	PERCOLATING WATER PRIVATE WATER RIGHTS IN FRANCE AND IN THE EASTERN UNITED STATES, W70-00919	06B
OYSTER REPLENISHMENT OYSTER RECORDS AND TAXES. W70-00979	06E	PERCOLATION A NUMERIC METHOD FOR ESTIMATING INFILTRATION, REDISTRIBUTION, DRAINAGE, AND EVAPORATION OF WATER FROM SOIL, W70-00862	02G
PERIPHYTE TESTS FIELD TEST RESULTS ON 113,000 KW FRANCIS PUMP-TURBINES FOR NAGANO POWER STATION, W70-01097	08C	PERFORMANCE TESTS ESTIMATES OF PERIPHYTE MASS AND STREAM BOTTOM AREA USING PHOSPHOROUS-32, W70-00846	02I
PERIPHYTE MASS MEASUREMENT ESTIMATES OF PERIPHYTE MASS AND STREAM BOTTOM AREA USING PHOSPHOROUS-32,			

		SUBJECT INDEX	PER-POL
W70-00846	02I		
PERMAFROST ON THE POSSIBILITY OF ESTIMATING THE THICKNESS OF UNCONSOLIDATED ROCKS BY VERTICAL ELECTRICAL SOUNDING IN PERMAFROST AREAS (RUSSIAN), W70-00878	07B	MAIN RECIRCULATING METHOD. AN HISTORICAL REVIEW, FIELD EVALUATION, AND SUGGESTED DESIGN PROCEDURES, W70-01088	04A
CERTAIN ASPECTS OF ENGINEERING GEOLOGY IN PERMAFROST, W70-01011	08D	PIPES ANALYTICAL SOLUTION FOR TURBULENT FLOW IN PIPES, W70-00870	08B
PERMEABILITY DETERMINING AQUIFER CHARACTERISTICS BY THE TIDAL METHOD, W70-00859	02P	PISCICIDES FISHERY MANAGEMENT WITH THE HELP OF THE ORGANOPHOSPHORUS INSECTICIDE, THIOMETON, W70-01232	05C
PERMITS FISH AND GAME (LICENSES). W70-00943	06E	PLANKTON THE DEVELOPMENT AND DISTRIBUTION OF PLANKTON IN THE NORTHERN PART OF THE WHITE NILE, W70-01007	02I
FISH AND FISHING GENERALLY MEAL, OIL. W70-00975	06E	PLANNING DYNAMIC ASPECTS OF URBAN WATER DEMAND, W70-00899	06D
FISH AND FISHING GENERALLY OTHER DEVICES. W70-00977	06E	APPLICATION OF DYNAMIC PROGRAMMING TO THE CONTROL OF WATER RESOURCES SYSTEMS, W70-00903	06A
CARRYING OYSTERS FROM STATE OR CERTAIN GROUNDS. W70-00980	06E	PLANT GROWTH THE DEVELOPMENT AND DISTRIBUTION OF PLANKTON IN THE NORTHERN PART OF THE WHITE NILE, W70-01007	02I
LICENSING OF STATIONARY AND FLOATING DUCK BLINDS. W70-00981	06E	FACTORS AFFECTING THE GROWTH OF NAJAS IN PICKWICK RESERVOIR, W70-01071	05C
FISHING PERMITS NATIONAL FORESTS. W70-00982	06E	EFFECTS OF EXTERNAL SALT CONCENTRATIONS ON WATER RELATIONS IN PLANTS SIGNIFICANCE OF EXTERNAL WATER-POTENTIAL AND SALT-TRANSPORT KINETICS ON RATE OF CELL EXPANSION, W70-01214	02I
FISHING IN INTERSTATE MONTIDAL WATERS. W70-01020	06E	PLANT PHYSIOLOGY EFFECTS OF EXTERNAL SALT CONCENTRATIONS ON WATER RELATIONS IN PLANTS SIGNIFICANCE OF EXTERNAL WATER-POTENTIAL AND SALT-TRANSPORT KINETICS ON RATE OF CELL EXPANSION, W70-01214	02I
CLUBS, PRESERVES, AND NATIONAL FORESTS COMPLIMENTARY LICENSES. W70-01021	06E	PLATE LOAD TESTS RELATION BETWEEN THE STATIC AND THE DYNAMIC DEFORMATION INDEXES OF ROCK IN LARGE-SCALE TESTS ON ROCK MASSES, W70-01124	08E
FISH (LICENSES AND PERMITS). W70-01148	06E	PLEISTOCENE EPOCH THE LAKE MISSOULA FLOODS AND THE CHANNELLED SCABLAND, W70-01012	02J
FISHING, HUNTING, TRAPPING PERMITS. W70-01160	06E	PLEISTOCENE ACTIVITY AND HOLOCENE STABILITY OF HILLSLOPES, WITH EXAMPLES FROM SCANDINAVIA AND PENNSYLVANIA, W70-01042	02J
PESTICIDE RESISTANCE PATTERNS OF INSECTICIDE RESISTANCE IN THE MOSQUITOPIFISH, GAMBUSSIA AFFINIS, W70-01226	05C	PLOWING METHOD FINAL REPORT TO THE AMERICAN SOCIETY OF CIVIL ENGINEERS ON TASK 7 AND TASK 9 OF THE COMBINED SEWER SEPARATION PROJECT, W70-01043	08A
PESTICIDE TOXICITY PATTERNS OF INSECTICIDE RESISTANCE IN THE MOSQUITOPIFISH, GAMBUSSIA AFFINIS, W70-01226	05C	PLUMBING FIXTURE TESTS PEAK FLOWS OF SEWAGE FROM INDIVIDUAL HOUSES, W70-01062	08B
PESTICIDES IMPLICATION OF WATER QUALITY AND SALINITY IN THE SURVIVAL OF FRASER RIVER SOCKEYE SMOLTS, W70-01225	05C	POISONS FISH POISONING POISONING WATER SUPPLY, W70-00949	05G
PHAEOPHYTA STUDIES ON ALGAL SUBSTANCES IN THE SEA. II. THE FORMATION OF GELARSTOFF (HUMIC MATERIAL) BY EXUDATES OF PHAEOPHYTA, W70-01072	05B	POLAND ROLE OF PROGNOSIS OF GROUNDWATER STATE IN PROJECTION OF DAMS (POLISH), W70-00874	08A
PHOSPHATE ABSORPTION STUDIES ON NATURAL FACTORS AFFECTING PHOSPHATE ABSORPTION AND ITS UTILIZATION BY ALGAE, W70-01031	05C	POLICY STATE POLICY AS TO WATERS. W70-00984	06E
PHOSPHATES STUDIES ON NATURAL FACTORS AFFECTING PHOSPHATE ABSORPTION AND ITS UTILIZATION BY ALGAE, W70-01031	05C	POLLUTANT IDENTIFICATION APPLICATION OF PYROLYTIC GAS CHROMATOGRAPHY TO NATURAL WATERS, W70-00847	05A
PHOSPHOROUS RADIOISOTOPES ESTIMATES OF PERIPHYTE MASS AND STREAM BOTTOM AREA USING PHOSPHOROUS-32, W70-00846	02I	STATISTICAL CHARACTERIZATION OF MIXTURES OF HYDROCARBONS, W70-01025	05A
PHOSPHORUS COMPOUNDS CAUSES AND CONSEQUENCES OF POND EUTROPHICATION (POLISH), W70-01082	05F	POLLUTANTS A RAPID FOR MEASURING THE ACUTE TOXICITY OF DISSOLVED MATERIALS TO MARINE FISHES, W70-00849	05A
PHOTOGAMMETRY PHOTOGAMMETRIC MEASUREMENT OF ROCK SURFACES IN A POWER TUNNEL, W70-01090	07B	STATUTORY STREAM POLLUTION CONTROL, W70-00924	05G
PHOTOGRAPHY MULTISENSOR ANALYSIS FOR SOILS MAPPING, W70-01125	07B	AVOIDANCE REACTIONS OF SALMONID FISH TO REPRESENTATIVE POLLUTANTS, W70-01032	05C
PICKWICK RESERVOIR(TENN-ALA) FACTORS AFFECTING THE GROWTH OF NAJAS IN PICKWICK RESERVOIR, W70-01071	05C	POLLUTION ABATEMENT THE USE OF THE FUNDAMENTAL STUDIES OF BIOLOGICAL PURIFICATION ON THE PURIFICATION OF POLLUTED WATERS DERIVED FROM PRODUCTION OF 'KHEMLON' (SLOVAKIAN), W70-00879	05D
PIPE FLOW ANALYTICAL SOLUTION FOR TURBULENT FLOW IN PIPES, W70-00870	08B	WATER QUALITY AND REGIONAL ECONOMY, A DECISION MODEL, W70-00897	05G
PIPELINES A WATER DISTRIBUTION SYSTEM FOR COLD REGIONS, THE SINGLE		STATUTORY STREAM POLLUTION CONTROL, W70-00923	05G

POL-PUM

SUBJECT INDEX

W70-00924	05G	PRESSURE CONTROL CONTROL TECHNIQUES FOR PRESSURIZED SEWERAGE SYSTEMS, W70-01064	
W70-00925	05G	PRESSURE SEWER ARRANGEMENTS FINAL REPORT TO THE AMERICAN SOCIETY OF CIVIL ENGINEERS ON TASK 7 AND TASK 9 OF THE COMBINED SEWER SEPARATION PROJECT, W70-01043	
W70-00926	05G	PRESSES CHARACTERISTIC PRESSURE DISTRIBUTION IN OUTLET WORKS INLETS, W70-01222	
WATER POLLUTION CONTROL AND ABATEMENT (BOOK REVIEW) CONTROLLING POLLUTION THE ECONOMICS OF A CLEANER AMERICA (BOOK REVIEW), W70-00933	05G	PRIOR APPROPRIATION PRIVATE WATER RIGHTS IN FRANCE AND IN THE EASTERN UNITED STATES, W70-00916	
SWEETWATER POLLUTION, W70-01104	05B	W70-00917	06B
THE ENVIRONMENT--AND WHAT TO DO ABOUT IT, W70-01106	04D	ACQUISITION OF THE RIGHT TO USE WATER, W70-01137	06E
POLLUTION CONTROL POLLUTION--CAUSES, COSTS, CONTROLS. W70-01100	06B	RIPARIAN WATER RIGHTS V A PRIOR APPROPRIATION SYSTEM A COMPARISON, W70-01139	06B
OXYGEN MANAGEMENT AND ARTIFICIAL REAERATION IN THE AREA OF BALDENNEY LAKE AND THE LOWER RUHR RIVER (IN GERMAN), W70-01224	05G	RIPARIAN WATERS RIGHTS V A PRIOR APPROPRIATION SYSTEM B COMPARISON, W70-01140	06B
POLLUTION PREVENTION GENERAL PROVISIONS OF THE STATE WATER CONTROL LAW. W70-01169	05G	RIPARIAN WATER RIGHTS V A PRIOR APPROPRIATION SYSTEM A COMPARISON, W70-01141	06B
POWERS AND DUTIES OF THE STATE WATER CONTROL BOARD. W70-01170	05G	W70-01142	06B
POLLUTION-TOLERANT ALGAE A COMPOSITE RATING OF ALGAE TOLERATING ORGANIC POLLUTION, W70-01233	05C	PROFILES THE ANALYSIS AND CLASSIFICATION OF SLOPE PROFILE FORMS, W70-01040	02J
POLYESTER CONDUIT HANGER DEVELOP AND FIELD TEST METHOD OF INSTALLING PRESSURE CONDUITS IN COMBINED SEWERS, W70-01044	08A	PHOTOGRAMMETRIC MEASUREMENT OF ROCK SURFACES IN A POWER TUNNEL, W70-01090	07B
POPULATION THE ASWAN HIGH DAM, W70-01201	06B	PUBLIC ACCEPTANCE FACTOR NUCLEAR POWER PLANT SITING IN THE PACIFIC NORTHWEST FOR THE BONNEVILLE POWER ADMINISTRATION, W70-00883	05D
PORE PRESSURE DETERMINING PORE PRESSURE IN SLIGHTLY PERMEABLE SOILS IN THE BODY OF A DAM DURING THE PROCESS OF THEIR CONSOLIDATION, W70-01091	08D	PUBLIC BENEFITS STATE POLICY AS TO WATERS. W70-00984	06E
POROSITY THE RELATIONSHIP BETWEEN THE ULTIMATE RESISTIVITY OF CLAYEY SANDSTONES AND THEIR POROSITY AND CLAY CONTENTS (RUSSIAN), W70-00876	07B	PUBLIC FASERMETS NAVIGABLE WATERS--ARTIFICIAL LAKE CONNECTED TO RIVER, W70-00937	04A
POROUS MEDIA THE RELATION OF ION MOVEMENT TO FINE PARTICLE DISPLACEMENT IN A SAND BED, W70-00909	05B	PUBLIC FERRIES FERRIES. W70-00913	04A
POROUS MEDIA FILTER RADIOTRACER STUDY OF RAPID SAND FILTRATION, W70-00910	05D	PUBLIC HEALTH DRAINAGE (CHICAGO SANITARY DISTRICT). W70-00940	04A
PORT AUTHORITIES CONSTRUCTION OF PORT FACILITIES. W70-01183	04A	FISH POISONING POISONING WATER SUPPLY. W70-00949	05G
POWER SYSTEM OPERATIONS IMPROVED DIGITAL SIMULATION FOR ANALYZING POWER SYSTEM DISTURBANCES, W70-01105	08C	PUBLIC POLICY LOWER MISSISSIPPI RIVER BASIN DEVELOPMENT DISTRICT. W70-00912	04A
POWER SYSTEM STABILITY IMPROVED DIGITAL SIMULATION FOR ANALYZING POWER SYSTEM DISTURBANCES, W70-01105	08C	PUBLIC RIGHTS GOVERNMENTAL RESTRICTION OF WATER USE, W70-00938	06D
PREFERENCES(WATER RIGHTS) HAS RECENT LEGISLATION LIMITED PRIVATE RIPARIAN RIGHTS IN IOWA, W70-01133	03D	CIVIL LAW PROPERTY--ENCROACHMENTS ON RIVER BANKS BY RIPARIAN OWNERS. W70-01135	04C
PRESSURE CONDUIT RELATIONSHIP OF SEWAGE CHARACTERISTICS TO CARRYING VELOCITY FOR PRESSURE SEWERS, W70-01047	08B	PUBLIC SERVICE CORPORATION RIGHT OF EMINENT DOMAIN OF PUBLIC SERVICE CORPORATIONS. W70-01176	06E
LONG-TERM OPERATION OF WASTEWATER OBSERVATION STATIONS (TASK 2), W70-01049	08B	PUBLIC WATER USES GENERAL PROVISIONS OF THE STATE WATER CONTROL LAW. W70-01169	05G
PRESSURE CONDUITS FINAL REPORT TO THE AMERICAN SOCIETY OF CIVIL ENGINEERS ON TASK 7 AND TASK 9 OF THE COMBINED SEWER SEPARATION PROJECT, W70-01043	08A	PUBLICATIONS THE CLIMATE OF CITIES A SURVEY OF RECENT LITERATURE, W70-00988	10
ANALYTICAL STUDIES OF TURBULENT FRICTION IN ANNULAR CONDUITS, W70-01045	08B	PUMP CHARACTERISTICS HYDRAULICS OF A PRESSURIZED SEWERAGE SYSTEM AND USE OF CENTRIFUGAL PUMPS, W70-01059	08C
TURBULENT FRICTION IN ECCENTRIC ANNULAR CONDUITS, W70-01046	08B	PUMP TURBINES FIELD TEST RESULTS ON 113,000 KW FRANCIS PUMP-TURBINES FOR NAGANO POWER STATION, W70-01097	08C
OUTLINE DESCRIPTION OF ASCE PROJECT ON "SEPARATION OF SANITARY SEWAGE FROM COMBINED SYSTEMS OF SEWERAGE". W70-01054	08A	PUMPING EXPERIENCE WITH GRINDING AND PUMPING OF SEWAGE FROM BUILDINGS, W70-01056	08C
MINIMUM TRANSPORT VELOCITY FOR PRESSURIZED SANITARY SEWERS, W70-01060	08B	PUMPS(CENTRIFUGAL) HYDRAULICS OF A PRESSURIZED SEWERAGE SYSTEM AND USE OF	

SUBJECT INDEX

PUM-RES

CENTRIFUGAL PUMPS, W70-01059	08C	THE STUDY OF LOCAL WATERS IN THE DESERTS OF THE USSR, W70-01216	03B
PYROLYTIC GAS CHROMATOGRAPHY APPLICATION OF PYROLYTIC GAS CHROMATOGRAPHY TO NATURAL WATERS, W70-00847	05A	RECIPROCAL AGREEMENTS FISHING IN INTERSTATE NONTIDAL WATERS. W70-01020	06E
QUATERNARY PERIOD THE DYNAMICS OF QUATERNARY SLOPE EVOLUTION AND ITS GEOMORPHOLOGICAL REPRESENTATION, W70-01041	02J	RECIRCULATED WATER ANALYSIS AND OPTIMIZATION OF A REVERSE OSMOSIS PURIFICATION SYSTEM--PART II. OPTIMIZATION, W70-00890	03A
RADAR MULTISENSOR ANALYSIS FOR SOILS MAPPING, W70-01125	07B	RECLAIMED WATER GASES FOR THE FUTURE, W70-01203	06B
RADAR IMAGES MULTISENSOR ANALYSIS FOR SOILS MAPPING, W70-01125	07B	RECOVERY FROM POLLUTION RECOVERY OF A SALT MARSH IN PEMBROKESHIRE, SOUTH-WEST WALES, FROM POLLUTION BY CRUDE OIL, W70-01231	05C
RADIOACTIVE TRACERS THE RELATION OF ION MOVEMENT TO FINE PARTICLE DISPLACEMENT IN A SAND BED, W70-00909	05B	RECREATION FACILITIES THE DILEMMA OF WATER RECREATION AND A SUGGESTED SOLUTION, W70-00930	06D
RADIOTRACER STUDY OF RAPID SAND FILTRATION, W70-00910	05D	THE DILEMMA OF WATER RECREATION AND A SUGGESTED SOLUTION (PART I), W70-00931	06D
RADIUS RATIO ANALYTICAL STUDIES OF TURBULENT FRICTION IN ANNULAR CONDUITS, W70-01045	08B	THE DILEMMA OF WATER RECREATION AND A SUGGESTED SOLUTION (PART II), W70-00932	06D
RAIN GAGES MEASURING RAINFALL ON FOREST CATCHMENTS, W70-00843	02B	REGIONAL ANALYSIS A SYSTEMS APPROACH TO WASTE MANAGEMENT, W70-00898	05D
SEASONAL VARIATION IN RAIN GAGE CATCH, W70-00854	02B	REGULATION SEA FOODS OYSTERS. W70-00970	06E
RAINBOW TROUT THE DIURETIC RESPONSE BY RAINBOW TROUT TO SUB-LETHAL CONCENTRATIONS OF AMMONIA, W70-00848	05C	FISH (LICENSES AND PERMITS). W70-01148	06E
RAINFALL MEASURING RAINFALL ON FOREST CATCHMENTS, W70-00843	02B	OFFENSES AGAINST PROPERTY BY FORCE. W70-01149	06E
ESTIMATION OF GRAZING CAPACITY ON ARID GRAZING LANDS, W70-01206	03F	OBSTRUCTIONS TO NAVIGATION. W70-01184	04A
RAINFALL DISPOSITION A LABORATORY STUDY OF SURFACE RUNOFF DUE TO MOVING RAINFALLS, W70-00839	02A	REMOTE SENSING MULTISENSOR ANALYSIS FOR SOILS MAPPING, W70-01125	07B
RAINFALL ROUTING A MODEL FOR RAINFALL ROUTING DURING INITIAL ABSTRACTION, W70-00844	02A	REND LAKE RESERVOIR SPILLWAY FOR REND LAKE RESERVOIR, BIG MUDDY RIVER, ILLINOIS HYDRAULIC MODEL INVESTIGATION, W70-01223	08B
RAINFALL VARIABILITY EFFECT OF RAINFALL VARIABILITY ON STREAMFLOW SIMULATION, W70-00850	02A	RESEARCH AND DEVELOPMENT EXPERIMENTAL RESEARCH ON SPILLWAY SHAFT FLOW (FRENCH). W70-00873	08E
RAINFALL-RUNOFF RELATIONSHIPS A LABORATORY STUDY OF SURFACE RUNOFF DUE TO MOVING RAINFALLS, W70-00839	02A	RESERVOIR CONSTRUCTION ROCKLAND COUNTY ANTI-RESERVOIR ASS'N V DURYEA (PREVENTION OF RESERVOIR CONSTRUCTION). W70-01147	04A
A MODEL FOR RAINFALL ROUTING DURING INITIAL ABSTRACTION, W70-00844	02A	RESERVOIR DESIGN SIMULATION OF RUNOFF FOR DESIGN OF WATER RESOURCE SYSTEMS, W70-00900	04A
EFFECT OF RAINFALL VARIABILITY ON STREAMFLOW SIMULATION, W70-00850	02A	STORAGE YIELD EXTENDING THE SEQUENT PEAK ALGORITHM TO MULTIPLE RESERVOIRS, W70-01000	06A
CONTINUOUS HYDROGRAPH SYNTHESIS WITH AN API-TYPE HYDROLOGIC MODEL, W70-00860	02A	RESERVOIR EVAPORATION THE ASWAN HIGH DAM, W70-01201	06B
A WATER YIELD MODEL DERIVED FROM MONTHLY RUNOFF DATA, W70-00905	03B	RESERVOIR LEAKAGE ROLE OF PROGNOSIS OF GROUNDWATER STATE IN PROJECTION OF DAMS (POLISH), W70-00874	08A
RANGE MANAGEMENT DIGITIZED PHYSICAL DATA OF A RANGELAND WATERSHED, W70-00993	07C	RESERVOIR OPERATION OPTIMIZATION OF THE LONG-TERM OPERATION OF A SINGLE-PURPOSE RESERVOIR, W70-00901	03B
RAPID SAND FILTRATION RADIOTRACER STUDY OF RAPID SAND FILTRATION, W70-00910	05D	STORAGE YIELD EXTENDING THE SEQUENT PEAK ALGORITHM TO MULTIPLE RESERVOIRS, W70-01000	06A
REAERATION STREAM REAERATION USING MOLECULAR OXYGEN, W70-01028	05G	EFFECT OF CHANGES OF STREAMFLOW REGIMEN ON RESERVOIR YIELD, W70-01001	04A
REASONABLE USE PRIVATE WATER RIGHTS IN FRANCE AND IN THE EASTERN UNITED STATES, W70-00916	06B	STOCHASTIC METHODS FOR ANALYZING RIVER BASIN SYSTEMS, W70-01085	06A
W70-00918	06B	RESERVOIR SILTING THE VOLUME AND CHARACTER OF SILTING-SEDIMENTATION OF THE SIONI RESERVOIR (RUSSIAN), W70-01019	02J
NOTES ON WATER WORKS LAW SECOND INSTALLMENT - IRRIGATION AND FIPARIAN RIGHTS, W70-00920	06B	RESERVOIR STORAGE STORAGE YIELD EXTENDING THE SEQUENT PEAK ALGORITHM TO MULTIPLE RESERVOIRS, W70-01000	06A
RECHARGE WATER-RETENTION CHARACTERISTICS OF COARSE ROCK PARTICLES, W70-00997	02G	SUBSURFACE FLOW REGIMES OF A HYDROLOGIC WATERSHED MODEL,	

W70-01237	02F	RIPARIAN PLANTS TAKING OF SEAWEED BY INHABITANTS OF BARRINGTON. W70-00985	06E
RESERVOIR YIELD EFFECT OF CHANGES OF STREAMFLOW REGIMEN ON RESERVOIR YIELD, W70-01001	04A	RIPARIAN RIGHTS PRIVATE WATER RIGHTS IN FRANCE AND IN THE EASTERN UNITED STATES, W70-00916	06B
RESERVOIRS A LIMNOLOGICAL COMPARISON OF TWO SMALL IDAHO RESERVOIRS, W70-01005	02H	W70-00917	06B
NEW PROBLEMS IN THE THEORY OF BOTTOM CURRENTS IN RESERVOIRS, W70-01129	08B	W70-00918	06B
ROCKLAND COUNTY ANTI-RESERVOIR ASS'N V DURYEA (PREVENTION OF RESERVOIR CONSTRUCTION). W70-01147	04A	NOTES ON WATER WORKS LAW SECOND INSTALLMENT - IRRIGATION AND RIPARIAN RIGHTS, W70-00920	06B
WATER SUPPLIES IN SOUTH AUSTRALIA, W70-01204	03B	COMMENT EXTENDING THE APPLICATION OF THE LAW OF ACCRETIONS. W70-00921	04A
RESIDUAL ORGANIC REMOVAL EFFECT OF POLYELECTROLYTES IN CONJUNCTION WITH BENTONITIC CLAY ON CONTAMINANTS REMOVAL FROM SECONDARY EFFLUENTS, W70-00845	05D	THE DILEMMA OF WATER RECREATION AND A SUGGESTED SOLUTION (PART II), W70-00932	06D
RESISTIVITY THE RELATIONSHIP BETWEEN THE ULTIMATE RESISTIVITY OF CLAYEY SANDSTONES AND THEIR POROSITY AND CLAY CONTENTS (RUSSIAN), W70-00876	07B	GOVERNMENTAL RESTRICTION OF WATER USE, W70-00938	06D
RESOURCE DEVELOPMENT VALUATION OF A GROUNDWATER SUPPLY FOR MANAGEMENT AND DEVELOPMENT, W70-00904	04B	SEA FOODS. W70-00969	06F
RESPIRATION THE INFLUENCE OF SUSPENDED SOLIDS ON THE RATE OF OXYGEN TRANSFER IN AQUEOUS SOLUTIONS, W70-01023	05D	LICENSING OF STATIONARY AND FLOATING DUCK BLINDS. W70-00981	06E
REVERSE OSMOSIS ANALYSIS AND OPTIMIZATION OF A REVERSE OSMOSIS PURIFICATION SYSTEM--PART II. OPTIMIZATION, W70-00890	03A	HAS RECENT LEGISLATION LIMITED PRIVATE RIPARIAN RIGHTS IN IOWA, W70-01133	03D
REVERSIBLE TURBINES FIELD TEST RESULTS ON 113,000 KW FRANCIS PUMP-TURBINES FOR NAGANO POWER STATION, W70-01097	08C	APPROPRIATION WATER LAW ELEMENTS IN RIPARIAN DOCTRINE STATES, W70-01134	06E
REVIEWS REVIEW OF METHODS FOR MEASURING AND PREDICTING SEEPAGE, W70-01238	04A	ACQUISITION OF THE RIGHT TO USE WATER, W70-01137	06E
RHEOLOGY CERTAIN ASPECTS OF ENGINEERING GEOLOGY IN PERMAFROST, W70-01011	08C	RIPARIAN WATER RIGHTS V A PRIOR APPROPRIATION SYSTEM A COMPARISON, W70-01139	06B
RHODE ISLAND TAKING OF SEAWEED BY INHABITANTS OF BARRINGTON. W70-00985	06E	RIPARIAN WATERS RIGHTS V A PRIOR APPROPRIATION SYSTEM A COMPARISON, W70-01140	06B
DUTIES OF DIRECTOR OF PUBLIC WORKS. W70-01182	04A	RIPARIAN WATER RIGHTS V A PRIOR APPROPRIATION SYSTEM A COMPARISON, W70-01141	06B
CONSTRUCTION OF PORT FACILITIES. W70-01183	04A	W70-01142	06B
OBSTRUCTIONS TO NAVIGATION. W70-01184	04A	LEASING OYSTER-PLANTING GROUNDS. W70-01164	03E
STAKES AND BUOYS. W70-01185	06E	TRANSFER OF OYSTER-PLANTING LEASES RIGHTS OF RIPARIANS. W70-01165	03E
RHODE ISLAND PILOTAGE REGULATION. W70-01186	04A	OWNERSHIP OF BEDS. W70-01168	06E
RHODE ISLAND WATER RESOURCES BOARD. W70-01187	06D	RIGHT OF EMINENT DOMAIN OF PUBLIC SERVICE CORPORATIONS. W70-01176	06E
W70-01188	06D	SURFACE RUNOFF AND FLOODWATER DIVERSION. W70-01177	04A
W70-01189	06D	DREDGING SAND AND GRAVEL AND MISCELLANEOUS OFFENSES (WATER POLLUTION) W70-01181	05G
W70-01190	06D	RIVER BASIN COMMISSIONS LOWER YAZOO RIVER BASIN DISTRICT. W70-00964	04A
NEW ENGLAND INTERSTATE WATER POLLUTION CONTROL COMMISSION. W70-01191	05G	W70-00965	04A
RIPARIAN LAND PRIVATE WATER RIGHTS IN FRANCE AND IN THE EASTERN UNITED STATES, W70-00918	06B	W70-00966	04A
COMMENT EXTENDING THE APPLICATION OF THE LAW OF ACCRETIONS. W70-00921	04A	RIVER BASIN DEVELOPMENT GOVERNMENTAL TECHNIQUES FOR THE CONSERVATION AND UTILIZATION OF WATER RESOURCES AN ANALYSIS AND PROPOSAL. W70-00935	06B
NEW JERSEY TURNPIKE AUTHORITY V SISSLERMAN (CONDAMNATION OF RIPARIAN LANE). W70-01155	06E	W70-00936	06B
RIPARIAN OWNERS GOVERNMENTAL RESTRICTION OF WATER USE, W70-00938	06D	LOWER YAZOO RIVER BASIN DISTRICT. W70-00964	04A
OWNERSHIP OF BEDS. W70-01168	06E	W70-00965	04A
		W70-00966	04A
		RIVER BASIN DISTRICTS BIG BLACK RIVER BASIN DISTRICT. W70-00961	04A
		W70-00962	04A
		W70-00963	04A
		PEARL RIVER BASIN DEVELOPMENT DISTRICT ACT. W70-01157	06B

		SUBJECT INDEX	RIV-SEA
W70-01158	06B	SALT-TRANSPORT KINETICS ON RATE OF CELL EXPANSION, W70-01214	02I
PEARL RIVER BASIN DEVELOPMENT ACT. W70-01159	06B	SALINE WATER FISH SEA FOODS. W70-00969	06E
RIVER BASINS BIG BLACK RIVER BASIN DISTRICT. W70-00961	04A	SALINITY EFFECTS OF EXTERNAL SALT CONCENTRATIONS ON WATER RELATIONS IN PLANTS SIGNIFICANCE OF EXTERNAL WATER-POTENTIAL AND SALT-TRANSPORT KINETICS ON RATE OF CELL EXPANSION, W70-01214	02I
W70-00962	04A	THE WATER PROBLEM IN THE DESERTS OF THE USSR, W70-01215	03B
W70-00963	04A	IMPLICATION OF WATER QUALITY AND SALINITY IN THE SURVIVAL OF FRASER RIVER SOCKEYE SMOLTS, W70-01225	05C
LOWER YAZOO RIVER BASIN DISTRICT. W70-00965	04A	SALINITY PREFERENCE IMPLICATION OF WATER QUALITY AND SALINITY IN THE SURVIVAL OF FRASER RIVER SOCKEYE SMOLTS, W70-01225	05C
STOCHASTIC METHODS FOR ANALYZING RIVER BASIN SYSTEMS, W70-01085	06A	SALMONID TEMPERATURE TOLERANCE WATER QUALITY CRITERIA FOR EUROPEAN FRESHWATER FISH REPORT ON WATER TEMPERATURE AND INLAND FISHERIES BASED MAINLY ON SLAVONIC LITERATURE. W70-01228	05C
PEARL RIVER BASIN DEVELOPMENT DISTRICT ACT. W70-01157	06B	SALT MARSH RECOVERY OF A SALT MARSH IN PEMBROKESHIRE, SOUTH-WEST WALES, FROM POLLUTION BY CRUDE OIL, W70-01231	05C
W70-01158	06B	SALVAGE SALVAGE, W70-00947	06E
PEARL RIVER BASIN DEVELOPMENT ACT. W70-01159	06B	SAN LUIS UNIT(CALIF) CONTROLLING THE EXPANSION OF DESICCATED CLAYS DURING CONSTRUCTION, W70-01112	08D
RIVER SYSTEMS SIMULATION OF RUNOFF FOR DESIGN OF WATER RESOURCE SYSTEMS, W70-00900	04A	SAND CONCENTRATION RELATIONSHIP OF SEWAGE CHARACTERISTICS TO CARRYING VELOCITY FOR PRESSURE SEWERS, W70-01047	08B
RIVERS WATER-DRAINAGE AND LEVEE DISTRICTS. W70-00942	04A	MINIMUM TRANSPORT VELOCITY FOR PRESSURIZED SANITARY SEWERS, W70-01060	08B
THE DEVELOPMENT AND DISTRIBUTION OF PLANKTON IN THE NORTHERN PART OF THE WHITE NILE, W70-01007	02I	SAND FILTERS THE RELATION OF ION MOVEMENT TO FINE PARTICLE DISPLACEMENT IN A SAND BED, W70-00909	05B
ROCK BREAKAGE ELECTRON BEAMS APPLY AN OLD PRINCIPLE TO MODERN ROCK- BREAKING, W70-01109	08H	SANDS ESTIMATION OF CLAY CONTENT OF SAND FORMATIONS FROM WELL- LOGGING DATA (RUSSIAN), W70-00877	07B
ROCK EXCAVATION ELECTRON BEAMS APPLY AN OLD PRINCIPLE TO MODERN ROCK- BREAKING, W70-01109	08H	SANDSTONES THE RELATIONSHIP BETWEEN THE ULTIMATE RESISTIVITY OF CLAYEY SANDSTONES AND THEIR POROSITY AND CLAY CONTENTS (RUSSIAN), W70-00876	07B
ROCK FOUNDATIONS RELATION BETWEEN THE STATIC AND THE DYNAMIC DEFORMATION INDEXES OF ROCK IN LARGE-SCALE TESTS ON ROCK MASSES, W70-01124	08E	SANITARY ENGINEERING DRAINAGE (CHICAGO SANITARY DISTRICT). W70-00940	04A
ROCK MECHANICS RELATION BETWEEN THE STATIC AND THE DYNAMIC DEFORMATION INDEXES OF ROCK IN LARGE-SCALE TESTS ON ROCK MASSES, W70-01124	08E	SANTA BARBARA COUNTY(CALIF) GROUNDWATER IN SANTA BARBARA COUNTY, CALIFORNIA, SPRING 1967 TO SPRING 1968, W70-00989	07C
ROCKFILL DAMS DECKED ROCKFILL DAMS, W70-01121	08D	SATURATED FLOW GROUNDWATER MOVEMENT TOWARD ARTIFICIAL CUTS, W70-00858	02F
ROUGHNESS ANALYTICAL STUDIES OF TURBULENT FRICTION IN ANNUULAR CONDUITS, W70-01045	08B	SCOMPUTERS IMPROVED DIGITAL SIMULATION FOR ANALYZING POWER SYSTEM DISTURBANCES, W70-01105	08C
ROUGHNESS COEFFICIENT HEAD LOSSES CAUSED BY AN ICE COVER ON OPEN CHANNELS, W70-01126	08B	SCOUR RELATIONSHIP OF SEWAGE CHARACTERISTICS TO CARRYING VELOCITY FOR PRESSURE SEWERS, W70-01047	08B
ROUGHNESS(HYDRAULIC) PHOTOGRAMMETRIC MEASUREMENT OF ROCK SURFACES IN A POWER TUNNEL, W70-01090	07B	MINIMUM TRANSPORT VELOCITY FOR PRESSURIZED SANITARY SEWERS, W70-01060	08B
HYDRAULIC PROPERTIES OF SMALL UNLINED ROCK TUNNELS, W70-01115	08B	SEA FOODS SEA FOODS. W70-00968	06E
ROUTING A MODEL FOR RAINFALL ROUTING DURING INITIAL ABSTRACTION, W70-00844	02A	SEA WATER THE OPTIMUM TEMPERATURE FOR THE OPERATION OF A NON-SCALING MULTI-STAGE FLASH EVAPORATOR PLANT, W70-00907	03A
AQUEDUCT ROUTE OPTIMIZATION BY DYNAMIC PROGRAMMING, W70-00894	04A	SEAFOOD INDUSTRY MARINE RESOURCES COMMISSION. W70-01162	03E
RUNOFF FORECASTING A LABORATORY STUDY OF SURFACE RUNOFF DUE TO MOVING RAINFALLS, W70-00839	02A	SEASONAL SEASONAL CHARACTERISTICS OF TWO SALINE LAKES IN WASHINGTON, W70-01076	02H
A MODEL FOR RAINFALL ROUTING DURING INITIAL ABSTRACTION, W70-00844	02A		
RUNOFF HYDROGRAPHS SUBSURFACE FLOW REGIMES OF A HYDROLOGIC WATERSHED MODEL, W70-01237	02F		
SALINE LAKES SEASONAL CHARACTERISTICS OF TWO SALINE LAKES IN WASHINGTON, W70-01076	02H		
SOME LIMNOLOGICAL FEATURES OF A SHALLOW SALINE MEROMICTIC LAKE, W70-01077	02H		
SALINE SOILS EFFECTS OF EXTERNAL SALT CONCENTRATIONS ON WATER RELATIONS IN PLANTS SIGNIFICANCE OF EXTERNAL WATER-POTENTIAL AND			

SEA-SIM

SUBJECT INDEX

SEASONAL TEMPERATURE TOLERANCE WATER QUALITY CRITERIA FOR EUROPEAN FRESHWATER FISH REPORT ON WATER TEMPERATURE AND INLAND FISHERIES BASED MAINLY ON SLAVONIC LITERATURE. W70-01228	05C	
SEAWATER STUDIES ON ALGAL SUBSTANCES IN THE SEA. III. THE FORMATION OF GELRSTOFF (HUMIC MATERIAL) BY EXUDATES OF PHAEOPHYTA, W70-01072	05B	
STUDIES ON ALGAL SUBSTANCES IN THE SEA. I. GELRSTOFF (HUMIC MATERIAL) IN TERRESTRIAL AND MARINE WATERS, W70-01074	05B	
SEAWEED TAKING OF SEAWEED BY INHABITANTS OF BARRINGTON. W70-00985	06E	
SEDIMENT TRANSPORT RELATIVE DENSITY EFFECTS ON INCIPENT BED MOVEMENT, W70-00865	02J	
FLUORESCENT SAND AS A TRACER OF FLUVIAL SEDIMENT, W70-00867	02J	
SEDIMENTARY ROCKS ESTIMATION OF CLAY CONTENT OF SAND FORMATIONS FROM WELL- LOGGING DATA (RUSSIAN). W70-00877	07B	
ON THE POSSIBILITY OF ESTIMATING THE THICKNESS OF UNCONSOLIDATED ROCKS BY VERTICAL ELECTRICAL SOUNDING IN PERMAFROST AREAS (RUSSIAN). W70-00878	07B	
SEDIMENTATION ANNOTATED BIBLIOGRAPHY ON HYDROLOGY AND SEDIMENTATION, 1963- 65, UNITED STATES AND CANADA. W70-00837	02J	
OPTIMIZATION OF THE ACTIVATED SLUDGE PROCESS-OPTIMUM VOLUME RATIO OF AERATION AND SEDIMENTATION VESSELS, W70-00893	05D	
SEEPAGE FIELD EVALUATION OF SEEPAGE MEASUREMENT METHODS. W70-01236	04A	
REVIEW OF METHODS FOR MEASURING AND PREDICTING SEEPAGE, W70-01238	04A	
SEEPAGE LOSSES FIELD EVALUATION OF SEEPAGE MEASUREMENT METHODS. W70-01236	04A	
SEISMIC DESIGN THE SEISMIC DESIGN STUDY OF A DOUBLE CURVATURE ARCH DAM, W70-01094	08A	
SEISMIC STUDIES ON A SOIL AND GROUND WATER INVESTIGATION WITH THE SHALLOW REFRACTION METHOD AT HO I RANA, W70-00995	07B	
SEISMIC TESTS THE SEISMIC DESIGN STUDY OF A DOUBLE CURVATURE ARCH DAM, W70-01094	08A	
SELF-PURIFICATION ON THE DIFFUSION PHENOMENA IN BOUNDARY LAYERS OF TURBULENT FLOW AND ITS INFLUENCE ON THE COURSE OF THE SELF- PURIFICATION OF SMALL STREAMS, W70-01037	05C	
SELF-PURIFICATION(RIVERS) ON THE DIFFUSION PHENOMENA IN BOUNDARY LAYERS OF TURBULENT FLOW AND ITS INFLUENCE ON THE COURSE OF THE SELF- PURIFICATION OF SMALL STREAMS, W70-01037	05C	
SEMIARID CLIMATES SOIL SLIPPAGE AN INDICATOR OF SLOPE INSTABILITY ON CHAPARRAL WATERSHEDS OF SOUTHERN CALIFORNIA. W70-01196	02J	
THE KHASHM EL GIEBA IRRIGATION SCHEME A NEW SOCIO-ECONOMIC PROJECT IN THE SUDAN, W70-01208	03F	
SEQUENTIAL PEAK ALGORITHM STORAGE YIELD EXTENDING THE SEQUENT PEAK ALGORITHM TO MULTIPLE RESERVOIRS, W70-01000	06A	
SETTLING VELOCITY MODIFIED RUBEE'S LAW ACCURATELY PREDICTS SEDIMENT SETTLING VELOCITIES, W70-00855	02J	
SEWAGE ANALYSIS RELATIONSHIP OF SEWAGE CHARACTERISTICS TO CARRYING VELOCITY FOR PRESSURE SEWERS, W70-01047	08B	
MINIMUM TRANSPORT VELOCITY FOR PRESSURIZED SANITARY SEWERS, W70-01060	08B	
SEWAGE DISPOSAL WASTEWATER DISPOSAL AND MICROBIAL ACTIVITY AT ICE-CAP FACILITIES,		
SEWAGE FLOW(HOUSEHOLD) SAMPLING AND ANALYSIS OF WASTE WATER FROM INDIVIDUAL HOMES (TASK 2), W70-01050	08B	
SEWAGE FLOW VARIATIONS IN INDIVIDUAL HOMES, W70-01055	08B	
PEAK FLOWS OF SEWAGE FROM INDIVIDUAL HOUSES, W70-01062	08B	
SEWAGE TREATMENT AN EXAMINATION OF THE BENEFITS AND DISADVANTAGES WITH RESPECT TO THE DISPOSAL OF SOLID WASTES, W70-01063	05D	
REGULATION OF SEWAGE DISCHARGE. W70-01171	05G	
SEWER SEPARATION REPORT ON PRESSURE SEWERAGE SYSTEM, SUMMER STREET SEPARATION STUDY AREA, BOSTON, MASSACHUSETTS, W70-01051	08A	
SEPARATION OF COMBINED WASTEWATER AND STORM DRAINAGE SYSTEMS, SAN FRANCISCO STUDY AREA. W70-01053	08A	
SEWER SIZES STUDY OF APPROXIMATE LENGTHS AND SIZES OF COMBINED SEWERS IN MAJOR METROPOLITAN CENTERS. W70-01057	08A	
SEWERAGE REGULATION OF SEWAGE DISCHARGE. W70-01171	05G	
SEWERS CATAC SYSTEM CONTROLS FOR REGULATION OF COMBINED SEWAGE FLOWS, W70-00889	05D	
STUDY OF APPROXIMATE LENGTHS AND SIZES OF COMBINED SEWERS IN MAJOR METROPOLITAN CENTERS, W70-01057	08A	
SEWFR-WITHIN-SEWER FINAL REPORT TO THE AMERICAN SOCIETY OF CIVIL ENGINEERS ON TASK 7 AND TASK 9 OF THE COMBINED SEWER SEPARATION PROJECT, W70-01043	08A	
PRESSURE TUBING FIELD INVESTIGATION, W70-01058	08A	
SHADOOF NEW WATER BIRD FOR EGYPT A ROBOT SHADOOF, W70-01205	03P	
SHAFTS(EXCAVATION) EXPERIMENTAL RESEARCH ON SPILLWAY SHAFT FLOW (FRANCHE), W70-00873	08B	
SHALES A LABORATORY INVESTIGATION OF BOREHOLE STABILITY. W70-01107	08E	
SHALLOWWATER SOME LINNOLOGICAL FEATURES OF A SHALLOW SALINE MEROMICTIC LAKE, W70-01077	02H	
SHEAR FAILURES STRENGTH OF DISCONTINUOUS ROCKS IN DIRECT SHEAR, W70-01101	08E	
SHEAR STRENGTH STRENGTH OF DISCONTINUOUS ROCKS IN DIRECT SHEAR, W70-01101	08E	
SHEET FLOODS SHFETFLOODS, STREAMFLOODS, AND THE FORMATION OF PEDIMENTS, W70-01211	02J	
SHELLFISH TAKING OYSTERS GENERALLY. W70-00978	06E	
SHELLS THE TAKING OF MINERALS FROM BEDS AND NAVIGATION. W70-00983	06E	
SHIPWRECKS OBSTRUCTIONS TO NAVIGATION. W70-01184	04A	
SILTING THE VOLUME AND CHARACTER OF SILTING-SEDIMENTATION OF THE SIONI RESERVOIR (RUSSIAN). W70-01019	02J	
SIMULATED RAINFALL SOIL MOVEMENT ON IRREGULAR SLOPES, W70-00864	02J	

SIMULATION		SOIL MAPS	
IMPROVED DIGITAL SIMULATION FOR ANALYZING POWER SYSTEM DISTURBANCES,	08C	MULTISENSOR ANALYSIS FOR SOILS MAPPING,	07B
W70-01105		W70-01125	
SIMULATION ANALYSIS		SOIL MECHANICS	
MATHEMATICAL SIMULATION OF THE ESTUARINE BEHAVIOR AND ITS APPLICATIONS,	05C	ADVANTAGES AND LIMITATIONS OF THE OBSERVATIONAL METHOD IN APPLIED SOIL MECHANICS,	08D
W70-00896		W70-01092	
SIMULATION OF RUNOFF FOR DESIGN OF WATER RESOURCE SYSTEMS,	04A	SOIL MOISTURE METER	
W70-00900		TEMPORAL, HORIZONTAL AND VERTICAL VARIABILITY OF WATER CHEMISTRY IN UNSATURATED ZONE OF FINE-GRAINED SOILS,	05B
A STOCHASTIC APPROACH TO THE DEVELOPMENT OF A REGULATION PLAN FOR THE GREAT LAKES.	02H	W70-00911	
W70-00902		SOIL WATER MOVEMENT	
THE USE OF A DIGITAL SIMULATION SYSTEM FOR THE MODELING AND PREDICTION OF WATER QUALITY.	05A	STEADY FLOW OF WATER THROUGH A TWO-LAYER SOIL,	02G
W70-01030		W70-00840	
SINKIANG		HYDROSTATICS AND HYDRODYNAMICS IN SWELLING SOILS,	02G
REGIONAL AND SEASONAL WATER SUPPLY IN THE TARIM BASIN AND ITS RELATION TO CULTIVATED LAND POTENTIALS,	03F	W70-00841	
W70-01210		A NUMERIC METHOD FOR ESTIMATING INFILTRATION, REDISTRIBUTION, DRAINAGE, AND EVAPORATION OF WATER FROM SOIL,	02G
SITE ECONOMIC FACTOR		W70-00862	
NUCLEAR POWER PLANT SITING IN THE PACIFIC NORTHWEST FOR THE BONNEVILLE POWER ADMINISTRATION,	05D	SOLIS	
W70-00883		PERSISTENCE OF DIAZINON AND ZINOPHOS IN SOIL EFFECTS OF AUTOCLAVING, TEMPERATURE, MOISTURE, AND ACIDITY,	02K
SITING CONSIDERATION		W70-01079	
NUCLEAR POWER PLANT SITING IN THE PACIFIC NORTHWEST FOR THE BONNEVILLE POWER ADMINISTRATION,	05D	SOIL-WATER-PLANT RELATIONSHIPS	
W70-00883		EFFECTS OF EXTERNAL SALT CONCENTRATIONS ON WATER RELATIONS IN PLANTS SIGNIFICANCE OF EXTERNAL WATER-POTENTIAL AND SALT-TRANSPORT KINETICS ON RATE OF CELL EXPANSION,	02I
SLIPPAGE		W70-01214	
SOIL SLIPPAGE AN INDICATOR OF SLOPE INSTABILITY ON CHAPARRAL WATERSHEDS OF SOUTHERN CALIFORNIA,	02J	SOLAR RADIATION	
W70-01196		NET RADIATION IN A BIPARTIAN MESQUITE COMMUNITY,	02I
SLOPE STABILITY		W70-00853	
PLEISTOCENE ACTIVITY AND HOLOCENE STABILITY OF HILLSLOPES, WITH EXAMPLES FROM SCANDINAVIA AND PENNSYLVANIA,	02J	THE THERMAL CLIMATE OF CITIES,	
W70-01042		W70-01241	05B
SOIL SLIPPAGE AN INDICATOR OF SLOPE INSTABILITY ON CHAPARRAL WATERSHEDS OF SOUTHERN CALIFORNIA,	02J	SOLIFLUTION	
W70-01196		PLEISTOCENE ACTIVITY AND HOLOCENE STABILITY OF HILLSLOPES, WITH EXAMPLES FROM SCANDINAVIA AND PENNSYLVANIA,	02J
SLOPES		W70-01042	
THE ANALYSIS AND CLASSIFICATION OF SLOPE PROFILE FORMS,	02J	SOUTH AUSTRALIA	
W70-01040		WATER SUPPLIES IN SOUTH AUSTRALIA,	03B
THE DYNAMICS OF QUATERNARY SLOPE EVOLUTION AND ITS GEOMORPHOLOGICAL REPRESENTATION,	02J	W70-01204	
W70-01041		SOUTH CAROLINA	
PLEISTOCENE ACTIVITY AND HOLOCENE STABILITY OF HILLSLOPES, WITH EXAMPLES FROM SCANDINAVIA AND PENNSYLVANIA,	02J	DAMS.	
W70-01042		W70-00891	04A
SLOVAKIA		SPAWNING	
THE USE OF THE FUNDAMENTAL STUDIES OF BIOLOGICAL PURIFICATION ON THE PURIFICATION OF POLLUTED WATERS DERIVED FROM PRODUCTION OF 'KHEMION' (SLOVAKIAN),	05D	FISH (SEASONS, LIMITS, SPAWNING GROUNDS).	06E
W70-00879		W70-00944	
SLURRIES		SPECIAL TOOLS	
EXPERIMENTAL STUDY OF SLURRY SEPARATORS FOR USE IN DESALINATION,	03A	FINAL REPORT TO THE AMERICAN SOCIETY OF CIVIL ENGINEERS ON TASK 7 AND TASK 9 OF THE COMBINED SEWER SEPARATION PROJECT,	08A
W70-00892		W70-01043	
SNOW		SPECIFIC RETENTION	
WASTEWATER DISPOSAL AND MICROBIAL ACTIVITY AT ICE-CAP FACILITIES,	05C	WATER-RETENTION CHARACTERISTICS OF COARSE ROCK PARTICLES,	02G
W70-00882		W70-00997	
STRENGTH TEST ON NEWLY FALLEN SNOW,	07B	SPECIFICATIONS	
W70-01221		FINAL REPORT TO THE AMERICAN SOCIETY OF CIVIL ENGINEERS ON TASK 7 AND TASK 9 OF THE COMBINED SEWER SEPARATION PROJECT,	08A
SNOW COVER		W70-01043	
STRENGTH TEST ON NEWLY FALLEN SNOW,	07B	SPILLWAYS	
W70-01221		EXPERIMENTAL RESEARCH ON SPILLWAY SHAFT FLOW (FRENCH),	08B
SNOWPACKS		W70-00873	
STRENGTH TEST ON NEWLY FALLEN SNOW,	07B	SPILLWAY FOR REND LAKE RESERVOIR, BIG MUDDY RIVER, ILLINOIS HYDRAULIC MODEL INVESTIGATION,	08B
W70-01221		W70-01223	
SOCKEYE SALMON		SPORT FISHING	
IMPLICATION OF WATER QUALITY AND SALINITY IN THE SURVIVAL OF FRASER RIVER SOCKEYE SMOLTS,	05C	FISHING IN INTERSTATE MONTIDAL WATERS.	06E
W70-01225		W70-01020	
SOIL ANALYSIS		SPRINGS	
USE OF A SELECTIVE ION ELECTRODE FOR DETERMINATION OF NITRATE IN SOILS,	05A	RECORDS OF SELECTED WELLS AND SPRINGS IN THE RULISON PROJECT AREA, GARFIELD AND MESA COUNTIES, COLORADO,	07C
W70-01075		W70-00987	
SOIL CLASSIFICATIONS		SPRINKLER IRRIGATION	
MULTISENSOR ANALYSIS FOR SOILS MAPPING,	07B	COMMUNITY IRRIGATION PROJECTS IN THE WAIKERIE DISTRICT OF SOUTH AUSTRALIA,	03F
W70-01125		W70-01207	
SOIL ENGINEERING		STANDARDS	
MULTISENSOR ANALYSIS FOR SOILS MAPPING,	07B	WATER QUALITY CRITERIA FOR EUROPEAN FRESHWATER FISH - WATER TEMPERATURE AND INLAND FISHERIES.	05C
W70-01125		W70-00880	
SOIL EROSION		STATISTICAL METHODS	
SOIL MOVEMENT ON IRREGULAR SLOPES,	02J	EFFECT OF RAINFALL VARIABILITY ON STREAMFLOW SIMULATION,	02A
W70-00864		W70-00850	
STATISTICAL MODELS		STATISTICAL METHODS	
FREQUENCY DISTRIBUTIONS OF STREAM LINK LENGTHS,	02J	W70-01006	

SUBJECT	INDEX	
STE-TAX		
STEADY FLOW STEADY FLOW OF WATER THROUGH A TWO-LAYER SOIL, W70-00840	02G	
GROUNDWATER MOVEMENT TOWARD ARTIFICIAL CUTS, W70-00858	02F	
STEAM COOLING TOWERS FOR STEAM-ELECTRIC STATIONS - ECONOMIC APPLICATIONS, W70-00887	05D	
STEREOSCOPIC PHOTOGRAMMETRIC MEASUREMENT OF ROCK SURFACES IN A POWER TUNNEL, W70-01090	07B	
STILLING BASINS CONVERGENT STILLING BASINS, W70-01099	08B	
STOCHASTIC PROCESSES A STOCHASTIC APPROACH TO THE DEVELOPMENT OF A REGULATION PLAN FOR THE GREAT LAKES, W70-00902	02H	
STOCHASTIC METHODS FOR ANALYZING RIVER BASIN SYSTEMS, W70-01085	06A	
STORAGE CAPACITY CATAD SYSTEM CONTROLS FOR REGULATION OF COMBINED SEWAGE FLOWS, W70-00889	05D	
STORAGE COEFFICIENT SUBSURFACE FLOW REGIMES OF A HYDROLOGIC WATERSHED MODEL, W70-01237	02F	
STORM RUNOFF CATAD SYSTEM CONTROLS FOR REGULATION OF COMBINED SEWAGE FLOWS, W70-00889	05D	
STORMS NATURAL FEATURES CAUSED BY A CATASTROPHIC STORM IN NELSON AND AMHERST COUNTIES, VIRGINIA., W70-00992	02E	
STRATIFICATION NEW THERMAL INVESTIGATION OF LAKES TRAUHSEE AND PUSCHLSEE (IN GERMAN), W70-00886	02H	
STREAM REAERATION STREAM REAERATION USING MOLECULAR OXYGEN, W70-01028	05G	
STREAMBEDS SALVAGE, W70-00947	06E	
STREAMFLOW A WATER YIELD MODEL DERIVED FROM MONTHLY RUNOFF DATA, W70-00905	03B	
EFFECT OF CHANGES OF STREAMFLOW REGIMEN ON RESERVOIR YIELD, W70-01001	04A	
MEASUREMENT OF COLUMBIA RIVER FLOW TIME FROM HANFORD REACTORS TO ASTORIA, OREGON-SUMMER 1966, W70-01002	02E	
STREAMFLOW FORECASTING CONTINUOUS HYDROGRAPH SYNTHESIS WITH AN API-TYPE HYDROLOGIC MODEL, W70-00860	02A	
STREAMS FREQUENCY DISTRIBUTIONS OF STREAM LINK LENGTHS, W70-01006	02J	
STREAM REAERATION USING MOLECULAR OXYGEN, W70-01028	05G	
STRESS A SEMI-EMPIRICAL METHOD FOR DETERMINING STRESSES BENEATH EMBANKMENTS, W70-01102	08D	
STRESS ANALYSIS A SEMI-EMPIRICAL METHOD FOR DETERMINING STRESSES BENEATH EMBANKMENTS, W70-01102	08D	
STRONTIUM RADIOISOTOPES STRONTIUM-90 CONCENTRATION FACTORS OF LAKE PLANKTON, MACROPHYTES, AND SUBSTRATES, W70-01010	05C	
SUBMERGED LAND GRANTS REAL PROPERTY--RIPARIAN GRANTS--LEGISLATIVE LIMITATIONS ON EXTENT OF GRANT. W70-00927	06B	
SUBSIDENCE LAND SUBSIDENCE DUE TO GROUND-WATER WITHDRAWAL, TULARE-WASCO AREA, CALIFORNIA, W70-01013	02F	
SUBSIDENCE(ATMOSPHERIC) WEATHER PATTERNS IN SOUTHERN WEST PAKISTAN,		
W70-01197	02B	
SUBSURFACE FLOW SUBSURFACE FLOW REGIMES OF A HYDROLOGIC WATERSHED MODEL, W70-01237	02F	
SUBSURFACE INVESTIGATIONS SURFACE AND SUBSURFACE EXPLORATION BY INFRARED SURVEYS, W70-01128	07B	
SUDAN THE DEVELOPMENT AND DISTRIBUTION OF PLANKTON IN THE NORTHERN PART OF THE WHITE NILE, W70-01007	02I	
THE LAND AND WATER USE SURVEY OF NORTH-CENTRAL KORDOFAN (1961-66), W70-01198	03B	
THE KHASHM EL GIRBA IRRIGATION SCHEME A NEW SOCIO-ECONOMIC PROJECT IN THE SUDAN, W70-01208	03F	
SUPERCRITICAL FLOW NON-LINEAR FREE SURFACES IN OPEN CHANNELS (FRENCH), W70-00871	08B	
SUPERVISORY CONTROL(POWER) DUTIES OF DIRECTOR OF PUBLIC WORKS. W70-01182	04A	
SURFACE RUNOFF CALCULATION OF WATER POLLUTION BY SURFACE RUNOFF, W70-01026	05B	
STOUDER V DASHNER (DOMINANT VERSUS SERVIENT LAND RIGHTS RELATING TO DRAINAGE OF SURFACE WATERS). W70-01146	04A	
SURFACE RUNOFF AND FLOODWATER DIVERSION. W70-01177	04A	
SURFACE WATERS PRIVATE WATER RIGHTS IN FRANCE AND IN THE EASTERN UNITED STATES, W70-00919	06B	
BASIC WATER USE DOCTRINES AND STATE WATER CONTROL AGENCIES. W70-01131	04A	
SURFACE-GROUNDWATER RELATIONSHIPS A CONJUNCTIVE OPERATION OF A SURFACE RESERVOIR AND A GROUNDWATER AQUIFER, W70-00906	02A	
SURVEYING PHOTOGRAMMETRIC MEASUREMENT OF ROCK SURFACES IN A POWER TUNNEL, W70-01090	07B	
SURVEYS ON A SOIL AND GROUND WATER INVESTIGATION WITH THE SHALLOW REFRACTION METHOD AT MO I RANA, W70-00995	07B	
SURVEYS OF AND RIGHTS IN OYSTER GROUNDS. W70-01163	03E	
THE LAND AND WATER USE SURVEY OF NORTH-CENTRAL KORDOFAN (1961-66), W70-01198	03B	
SUSPENDED LOAD THE INFLUENCE OF SUSPENDED SOLIDS ON THE RATE OF OXYGEN TRANSFER IN AQUEOUS SOLUTIONS, W70-01023	05D	
SWAMPS SWAMP LAND DISTRICTS. W70-00953	04A	
SWEDEN GLACIAL HISTORY AND MORPHOLOGY OF WEST SWEDEN (SWEDISH), W70-00998	02C	
SWITZERLAND DIAGENETIC CHANGES IN INTERSTITIAL WATERS OF HOLOCENE LAKE CONSTANCE SEDIMENTS, W70-01009	02H	
SYNTHESIZED PEAK DISCHARGES PEAK FLOWS OF SEWAGE FROM INDIVIDUAL HOUSES, W70-01062	08B	
SYNTHETIC HYDROLOGY SIMULATION OF RUNOFF FOR DESIGN OF WATER RESOURCE SYSTEMS, W70-00900	04A	
SYSTEMS ANALYSIS A SYSTEMS APPROACH TO WASTE MANAGEMENT, W70-00898	05D	
GENERAL SYSTEMS APPROACH TO GROUND-WATER PROBLEMS, W70-01123	02F	
TARIM BASIN REGIONAL AND SEASONAL WATER SUPPLY IN THE TARIM BASIN AND ITS RELATION TO CULTIVATED LAND POTENTIALS, W70-01210	03F	
TAX RATE		

SUBJECT INDEX		TAX-TUR
PAT HARRISON WATERWAY DISTRICT. W70-00960	05G	INSECTICIDE, THIOMETON, W70-01232
TAXES OYSTER RECORDS AND TAXES. W70-00979	06E	05C
RHODE ISLAND WATER RESOURCES BOARD. W70-01190	06D	TIDAL EFFECTS DETERMINING AQUIFER CHARACTERISTICS BY THE TIDAL METHOD, W70-00859
TEMPERATURE WATER QUALITY CRITERIA FOR EUROPEAN FRESHWATER FISH - WATER TEMPERATURE AND INLAND FISHERIES. W70-00880	05C	02F
INCREASES IN MAXIMUM STREAM TEMPERATURES AFTER SLASH BURNING IN A SMALL EXPERIMENTAL WATERSHED. W70-01220	07C	TIDAL WATERS REAL PROPERTY--RIPARIAN GRANTS--LEGISLATIVE LIMITATIONS ON EXIFNT OF GRANT. W70-00927
CITY AIR - BETTER OR WORSE. W70-01239	05B	06B
SOME OBSERVATIONS OF CLOUD INITIATION IN INDUSTRIAL AREAS. W70-01240	05C	TISZA RIVER (HUNGARY) APPROACH TO DETERMINE THE MINIMUM ALLOWABLE FLOW IN THE TISZA RIVER, HUNGARY, W70-01035
TEMPERATURE ACCLIMATIZATION WATER QUALITY CRITERIA FOR EUROPEAN FRESHWATER FISH REPORT ON WATER TEMPERATURE AND INLAND FISHERIES BASED MAINLY ON SLAVONIC LITERATURE. W70-01228	05C	05G
TEMPERATURE CONTROL THE OPTIMUM TEMPERATURE FOR THE OPERATION OF A NON-SCALING MULTI-STAGE FLASH EVAPORATOR PLANT. W70-00907	03A	TOMBIGBEE RIVER TOMBIGBEE RIVER VALLEY WATER MANAGEMENT DISTRICT. W70-00957
TEMPERATURE EFFECTS WATER QUALITY CRITERIA FOR EUROPEAN FRESHWATER FISH LIST OF LITERATURE ON THE EFFECT OF WATER TEMPERATURE ON FISH. W70-01227	05C	04A
TEMPERATURE RANGE WATER QUALITY CRITERIA FOR EUROPEAN FRESHWATER FISH REPORT ON WATER TEMPERATURE AND INLAND FISHERIES BASED MAINLY ON SLAVONIC LITERATURE. W70-01228	05C	TOPOGRAPHY FREQUENCY DISTRIBUTIONS OF STREAM LINK LENGTHS, W70-01006
TEMPERATURE REQUIREMENTS WATER QUALITY CRITERIA FOR EUROPEAN FRESHWATER FISH LIST OF LITERATURE ON THE EFFECT OF WATER TEMPERATURE ON FISH. W70-01227	05C	02J
TERRAIN ANALYSIS THE ANALYSIS AND CLASSIFICATION OF SLOPE PROFILE FORMS, W70-01040	02J	THE LAKE MISSOULA FLOODS AND THE CHANNELLED SCABLAND, W70-01012
TERTIARY TREATMENT EFFECT OF POLYELECTROLYTES IN CONJUNCTION WITH BENTONITIC CLAY ON CONTAMINANTS REMOVAL FROM SECONDARY EFFLUENTS, W70-00845	05D	05C
TEST RESULTS FIELD TEST RESULTS ON 113,000 KW FRANCIS PUMP-TURBINES FOR NAGANO POWER STATION. W70-01097	08C	A RAPID FOR MEASURING THE ACUTE TOXICITY OF DISSOLVED MATERIALS TO MARINE FISHES, W70-00849
THEORETICAL MOMENTS ROUTING OF FLOWS IN SANITARY SEWERAGE SYSTEMS, W70-01067	08A	05A
Thermal Degradation WASTEWATER DISPOSAL AND MICROBIAL ACTIVITY AT ICE-CAP FACILITIES, W70-00882	05C	TRACE ELEMENTS DISTINGUISHING MARINE AND FRESHWATER MUDS, W70-00994
Thermal Effects PERSISTENCE OF DIAZINON AND ZINOPHOS IN SOIL EFFECTS OF AUTOCLOAVING, TEMPERATURE, MOISTURE, AND ACIDITY, W70-01079	02K	02K
Thermal Pollution NUCLEAR POWER PLANT SITING IN THE PACIFIC NORTHWEST FOR THE BONNEVILLE POWER ADMINISTRATION, W70-00883	05D	TRACERS FLUORESCENT SAND AS A TRACER OF FLUVIAL SEDIMENT, W70-00867
COPING WITH COOLING TOWER BLOWDOWN, W70-00884	05D	02J
THE USE OF A DIGITAL SIMULATION SYSTEM FOR THE MODELING AND PREDICTION OF WATER QUALITY, W70-01030	05A	MEASUREMENT OF COLUMBIA RIVER FLOW TIME FROM HANFORD REACTORS TO ASTORIA, OREGON-SUMMER 1966, W70-01002
WATER QUALITY CRITERIA FOR EUROPEAN FRESHWATER FISH LIST OF LITERATURE ON THE EFFECT OF WATER TEMPERATURE ON FISH. W70-01227	05C	02E
Thermal Properties NEW THERMAL INVESTIGATION OF LAKES TRAUHSEE AND FUSCHLSEE (IN GERMAN), W70-00886	02H	THE USE OF A DIGITAL SIMULATION SYSTEM FOR THE MODELING AND PREDICTION OF WATER QUALITY, W70-01030
Thermal Stratification CAUSES AND CONSEQUENCES OF POND EUTROPHICATION (POLISH), W70-01082	05F	05B
Thermal Water A SCHEME OF GEOTHERMAL WATERS OF CENTRAL ASIA (RUSSIAN), W70-00869	02F	TRANSMISSION LINES ELECTRICAL DESIGN OF PARAMETERS USED FOR EHV SYSTEMS, W70-01093
THIOMETON FISHERY MANAGEMENT WITH THE HELP OF THE ORGANOPHOSPHORUS		08C
		TRANSMISSIBILITY DETERMINING AQUIFER CHARACTERISTICS BY THE TIDAL METHOD, W70-00859
		TRANSPORT VELOCITY MINIMUM TRANSPORT VELOCITY FOR PRESSURIZED SANITARY SEWERS, W70-01060
		08B
		TUNNEL DESIGN HYDRAULIC DESIGN OF UNLINED ROCK TUNNELS, W70-01114
		08E
		TUNNEL HYDRAULICS PHOTOGGRAMMETRIC MEASUREMENT OF ROCK SURFACES IN A POWER TUNNEL, W70-01090
		07B
		HYDRAULIC DESIGN OF UNLINED ROCK TUNNELS, W70-01114
		08E
		HYDRAULIC PROPERTIES OF SMALL UNLINED ROCK TUNNELS, W70-01115
		08B
		TUNNELS PHOTOGRAMMETRIC MEASUREMENT OF ROCK SURFACES IN A POWER TUNNEL, W70-01090
		07B
		HYDRAULIC DESIGN OF UNLINED ROCK TUNNELS, W70-01114
		08E
		HYDRAULIC PROPERTIES OF SMALL UNLINED ROCK TUNNELS, W70-01115
		08B
		TURBULENT FLOW A STUDY OF HOT WIRE AND HOT FILM ANEMOMETERS IN WATER (FRENCH), W70-00868
		07B
		ANALYTICAL SOLUTION FOR TURBULENT FLOW IN PIPES, W70-00870
		08B

TURGOR PRESSURE EFFECTS OF EXTERNAL SALT CONCENTRATIONS ON WATER RELATIONS IN PLANTS SIGNIFICANCE OF EXTERNAL WATER-POTENTIAL AND SALT-TRANSPORT KINETICS ON RATE OF CELL EXPANSION, W70-01214	021	VELOCITY DISTRIBUTION ANALYTICAL STUDIES OF TURBULENT FRICTION IN ANNULAR CONDUITS, W70-01045	08B
ULTRA HIGH VOLTAGE ELECTRICAL DESIGN OF PARAMETERS USED FOR EHV SYSTEMS, W70-01093	08C	VIBRATIONS DETECTION OF CAVITATION BY ACOUSTIC AND VIBRATION- MEASUREMENT METHODS, W70-00875	08B
UNCONFINED FLOW TIME VARIANT GROUND WATER FLOW BY RESISTANCE NETWORK ANALOGUES, W70-01039	02F	VIRGINIA CONDENMATION BY CITIES AND COUNTIES TO PROVIDE WATERSHEDS OR BEDS FOR WATER PIPES. W70-00973	04A
UNDERGROUND STORAGE THE STUDY OF LOCAL WATERS IN THE DESERTS OF THE USSR, W70-01216	03B	INSPFCTION DISTRICTS POLICE FLEET. W70-00974	06E
UNDERGROUND STREAMS PRIVATE WATER RIGHTS IN FRANCE AND IN THE EASTERN UNITED STATES, W70-00919	06B	FISH AND FISHING GENERALLY FISH FOR MANUFACTURE INTO FISH MEAL, OIL. W70-00975	06E
UNITED ARAB REPUBLIC THE ASWAN HIGH DAM, W70-01201	06B	FISH AND FISHING GENERALLY TROLLS, TRAWL NETS, AND DRAG NETS. W70-C0976	06E
UNLINED TUNNELS HYDRAULIC DESIGN OF UNLINED ROCK TUNNELS, W70-01114	08F	FISH AND FISHING GENERALLY MARKING OF BOATS, NETS, AND OTHER DEVICES. W70-00977	06E
HYDRAULIC PROPERTIES OF SMALL UNLINED ROCK TUNNELS, W70-01115	08B	TAKING OYSTERS GENERALLY. W70-00978	06E
UNSTEADY FLOW PROPAGATION OF WAVE-FRONTS IN WIDE CHANNELS OF ARBITRARY CROSS-SECTION, W70-00872	08B	OYSTER RECORDS AND TAXES. W70-00979	06E
UPLIFT RESISTANCE UPLIFT RESISTANCE OF ANCHOR BAR, AUGER AND PRESSED PLATE FOOTINGS IN SANDY SILT, W70-01096	08C	CARRYING OYSTERS FROM STATE OR CERTAIN GROUNDS. W70-C0980	06E
URBAN AREAS THE THERMAL CLIMATE OF CITIES, W70-01241	05B	LICENSING OF STATIONARY AND FLOATING DUCK BLINDS. W70-00981	06E
URBAN CLIMATOLOGY THE CLIMATE OF CITIES A SURVEY OF RECENT LITERATURE, W70-00988	10	FISHING PERMITS NATIONAL FORESTS. W70-00982	06E
URBAN HEAT ISLAND THE THERMAL CLIMATE OF CITIES, W70-01241	05B	THE TAKING OF MINERALS FROM BEDS AND NAVIGATION. W70-00983	06E
URBAN RUNOFF CALCULATION OF WATER POLLUTION BY SURFACE RUNOFF, W70-01026	05B	STATE POLICY AS TO WATERS. W70-00984	06F
URBANIZATION THE CHANGING ROLE OF WATER IN ARID LANDS, W70-01199	06B	NATURAL FEATURES CAUSED BY A CATASTROPHIC STORM IN NELSON AND AMHERST COOUNTIES, VIRGINIA., W70-00992	02I
URBAN-RURAL CLIMATES THE CLIMATE OF CITIES A SURVEY OF RECENT LITERATURE, W70-C0988	10	FISHING IN INTERSTATE MONTIDAL WATERS. W70-01020	06E
USSR ON THE HYDROGEOLOGY OF THE CENTRAL AND NORTHWESTERN PART OF THE DNIPIPER-DONETS ARTESIAN BASIN (UKRAINIAN), W70-00866	02K	CLUBS, PRESERVES, AND NATIONAL FORESTS COMPLIMENTARY LICENSES. W70-01021	06E
A SCHMIE OF GEOTHERMAL WATERS OF CENTRAL ASIA (RUSSIAN), W70-00869	02F	FISHING, HUNTING, TRAPPING PERMITS. W70-01160	06E
THE RELATIONSHIP BETWEEN THE ULTIMATE RESISTIVITY OF CLAYEY SANDSTONES AND THEIR POROSITY AND CLAY CONTENTS (RUSSIAN), W70-00876	07B	FISH, OYSTERS, SHELLFISH, AND OTHER MARINE LIFE MARINE RESOURCES COMMISSION AND COMMISSIONER OF MARINE RESOURCES. W70-01161	03E
STRONTIUM-90 CONCENTRATION FACTORS OF LAKE PLANCKTON, MACROPHYTES, AND SUBSTRATES, W70-01010	05C	MARINE RESOURCES COMMISSION. W70-01162	03E
STATISTICAL STRUCTURE OF VERTICAL HUMIDITY PROFILES (RUSSIAN), W70-01016	02B	SURVEYS OF AND RIGHTS IN OYSTER GROUNDS. W70-01163	03E
THE VOLUME AND CHARACTER OF SILTING-SEDIMENTATION OF THE SIONI RESERVOIR (RUSSIAN), W70-01019	02J	LEASING OYSTER-PLANTING GROUNDS. W70-01164	03E
CALCULATION OF WATER POLLUTION BY SURFACE RUNOFF, W70-01026	05B	TRANSFER OF OYSTER-PLANTING LEASES RIGHTS OF RIPARIANS. W70-01165	03E
THE WATER PROBLEM IN THE DESERTS OF THE USSR, W70-01215	03B	CULLING OYSTERS. W70-01166	03E
THE STUDY OF LOCAL WATERS IN THE DESERTS OF THE USSR, W70-01216	03B	FISH LAWS. W70-01167	06E
VARIABILITY EFFECT OF RAINFALL VARIABILITY ON STREAMFLOW SIMULATION, W70-00850	02A	OWNERSHIP OF BEDS. W70-01168	06E
A STUDY OF HOT WIRE AND HOT FILM ANEMOMETERS IN WATER (FRENCH), W70-00868	07B	GENERAL PROVISIONS OF THE STATE WATER CONTROL LAW. W70-01169	05G
		POWERS AND DUTIES OF THE STATE WATER CONTROL BOARD. W70-01170	05G
		REGULATION OF SEWAGE DISCHARGE. W70-01171	05G
		PENALTIES FOR POLLUTION AND POLLUTION FROM BOATS. W70-01172	05G
		INTERSTATE COMMISSION ON THE POTOMAC RIVER BASIN. W70-01173	05G
		OHIO RIVER VALLEY WATER SANITATION COMMISSION. W70-01174	05G
		WATER-POWER DEVELOPMENT, CONSERVATION OF HYDROELECTRIC POWER DAMS AND WORKS. W70-01175	06E

RIGHT OF EMINENT DOMAIN OF PUBLIC SERVICE CORPORATIONS.	STATE POLICY AS TO WATERS. W70-00984	06E
W70-01176	06E	
SURFACE RUNOFF AND FLOODWATER DIVERSION.	SWEETWATER POLLUTION, W70-01104	05B
W70-01177	04A	
MILLS, DAMS, AND CERTAIN OTHER WORKS ON WATERCOURSES.	WATER CONTROL POWERS AND DUTIES OF THE STATE WATER CONTROL BOARD. W70-01170	05G
W70-01178	04A	
FEDERAL WATER RESOURCES DEVELOPMENT.	WATER CONVEYANCE NEW WATER BIRD FOR EGYPT A ROBOT SHADOF,	05F
W70-01179	06B	
IMPROVEMENT OF NAVIGABILITY OF STREAMS.	W70-01205	03F
W70-01180	04A	
DREDGING SAND AND GRAVEL AND MISCELLANEOUS OFFENSES (WATER POLLUTION)	WATER CRITERIA THE FEDERAL GOVERNMENT AND AIR AND WATER POLLUTION, W70-01136	05G
W70-01181	05G	
WARNING SYSTEMS EVALUATION OF BENEFITS OF A FLOOD WARNING SYSTEM,	WATER DEMAND DYNAMIC ASPECTS OF URBAN WATER DEMAND, W70-00899	06D
W70-00838	06B	
WASHINGTON SEASONAL CHARACTERISTICS OF TWO SALINE LAKES IN WASHINGTON,	WATER RESOURCES AND THE CHEMICAL INDUSTRY IN NEW JERSEY AN ECONOMETRIC AND ENGINEERING ANALYSIS, W70-01217	06D
W70-01076	02H	
WASTE DILUTION DILUTION OF WASTE EFFLUENTS IN WATERS (IN RUSSIAN),	WATER DEMAND(HOUSEHOLD) SAMPLING AND ANALYSIS OF WASTE WATER FROM INDIVIDUAL HOMES (TASK 2), W70-01050	08B
W70-01084	05G	
WASTEWATER DISCHARGE GENERAL PROVISIONS OF THE STATE WATER CONTROL LAW.	SEWAGE FLOW VARIATIONS IN INDIVIDUAL HOMES, W70-01055	08B
W70-01169	05G	
WASTE DISPOSAL OIL FIELDS YIELD NEW DEEP-WELL DISPOSAL TECHNIQUE,	PEAK FLOWS OF SEWAGE FROM INDIVIDUAL HOUSES, W70-01062	08B
W70-00990	05E	
PENALTIES FOR POLLUTION AND POLLUTION FROM BOATS.		
W70-01172	05G	
WASTE WATER TREATMENT A SYSTEMS APPROACH TO WASTE MANAGEMENT,	WATER DEMAND(RESIDENTIAL) DOMESTIC SEWAGE FLOW CRITERIA FOR EVALUATION OF PROJECT SCHEME TO ACTUAL COMBINED SEWER DRAINAGE AREAS, W70-01061	08B
W70-00898	05D	
WASTEWATER SAMPLING STATIONS LONG-TERM OPERATION OF WASTEWATER OBSERVATION STATIONS (TASK 2),	WATER DISTRICTS PAT HARRISON WATERWAY DISTRICT. W70-00958	05G
W70-01049	08B	
SAMPLING AND ANALYSIS OF WASTE WATER FROM INDIVIDUAL HOMES (TASK 2),	W70-00959	05G
W70-01050	08B	
WATER ALLOCATION(POLICY) LOWER MISSISSIPPI RIVER BASIN DEVELOPMENT DISTRICT.	W70-00960	05G
W70-00912	04A	
BASIC CONCEPTS IN GROUND WATER LAW,	LOWER YAZOO RIVER BASIN DISTRICT. W70-00964	04A
W70-00914	04B	
HAS RECENT LEGISLATION LIMITED PRIVATE RIPARIAN RIGHTS IN IOWA,	W70-00966	04A
W70-01133	03D	
THE CHANGING ROLE OF WATER IN ARID LANDS,	W70-00967	04A
W70-01199	06B	
WATER ANALYSIS USE OF MEMBRANE FILTERS IN GRAVIMETRIC ANALYSES OF PARTICULATE MATTER IN NATURAL WATERS,	WATER IMPROVEMENT THE WATER PROBLEM IN THE DESERTS OF THE USSR, W70-01215	03B
W70-00857	07B	
WATER CHEMISTRY ON THE HYDROGEOLOGY OF THE CENTRAL AND NORTHWESTERN PART OF THE DNEPRER-DONETS ARTESIAN BASIN (UKRAINIAN),	WATER LEVEL FLUCTUATIONS LAND SUBLIMATION DUE TO GROUND-WATER WITHDRAWAL, TULARE-WASCO AREA, CALIFORNIA, W70-01013	02F
W70-00866	02K	
DIAGENETIC CHANGES IN INTERSTITIAL WATERS OF HOLOCENE LAKE CONSTANCE SEDIMENTS,	WATER LEVELS ROLE OF PROGNOSIS OF GROUNDWATER STATE IN PROJECTION OF DAMS (POLISH), W70-00874	08A
W70-01009	02H	
STRONTIUM-90 CONCENTRATION FACTORS OF LAKE PLANKTON, MACROPHYTES, AND SUBSTRATES,	AN INEXPENSIVE SHALLOW WATER TABLE PROBE, W70-00996	07B
W70-01010	05C	
WATER CONSERVATION LOWER MISSISSIPPI RIVER BASIN DEVELOPMENT DISTRICT.	WATER MANAGEMENT DISTRICTS TOMBIGBEE RIVER VALLEY WATER MANAGEMENT DISTRICT. W70-00955	04A
W70-00912	04A	
GOVERNMENTAL TECHNIQUES FOR THE CONSERVATION AND UTILIZATION OF WATER RESOURCES AN ANALYSIS AND PROPOSAL.	W70-00957	04A
W70-00934	06B	
TOMBIGBEE RIVER VALLEY WATER MANAGEMENT DISTRICT.	WATER MANAGEMENT(APPLIED) WISCONSIN LAW OF WATERS, W70-01138	04A
W70-00955	04A	
W70-00956	04A	
PAT HARRISON WATERWAY DISTRICT.	WATER MANAGEMENT DISTRICTS TOMBIGBEE RIVER VALLEY WATER MANAGEMENT DISTRICT. W70-00956	04A
W70-00958	04A	
W70-00959	04A	
W70-00960	04A	
WATER POLICY PAT HARRISON WATERWAY DISTRICT.	WATER MANAGEMENT(APPLIED) VALUATION OF A GROUNDWATER SUPPLY FOR MANAGEMENT AND DEVELOPMENT, W70-00904	04B
W70-00958	05G	
W70-00959	05G	
W70-00960	05G	
STATEMENTS OF POLICY ON PUBLIC WATER SUPPLY MATTERS-- AMERICAN WATER WORKS ASS'N PRINCIPLES OF NATIONAL WATER POLICY.	WATER POLICY PAT HARRISON WATERWAY DISTRICT.	05G
W70-01130	05G	
BASIC WATER USE DOCTRINES AND STATE WATER CONTROL AGENCIES.	W70-01131	04A
W70-01131	04A	
APPROPRIATION WATER LAW ELEMENTS IN RIPARIAN DOCTRINE STATES,	APPROPRIATION WATER LAW ELEMENTS IN RIPARIAN DOCTRINE STATES, W70-01134	06E
W70-01134	06E	
RHODE ISLAND WATER RESOURCES BOARD.	RHODE ISLAND WATER RESOURCES BOARD.	06D
W70-01187	06D	

W70-01188	06D	OHIO RIVER VALLEY WATER SANITATION COMMISSION. W70-01174 05G
W70-01189	06D	NEW ENGLAND INTERSTATE WATER POLLUTION CONTROL COMMISSION. W70-01191 05G
WATER POLLUTION THE CONSTITUTIONAL ASPECTS OF WATER POLLUTION AND THE NEED FOR GOVERNMENTAL COOPERATION, W70-00915	05G	WATER POLLUTION EFFECTS PHYSICAL AND BIOCHEMICAL ASPECTS OF POD KINETICS, W70-01024 05C
WATER POLLUTION CONTROL AND ABATEMENT (BOOK REVIEW) CONTROLLING POLLUTION THE ECONOMICS OF A CLEANER AMERICA (BOOK REVIEW), W70-00933	05G	AVOIDANCE REACTIONS OF SALMONID FISH TO REPRESENTATIVE POLLUTANTS, W70-01032 05C
GOVERNMENTAL RESTRICTION OF WATER USE, W70-00938	06D	WATER POLLUTION SOURCES GEOLOGY, PETROLEUM DEVELOPMENT, AND SEISMICITY OF THE SANTA BARBARA CHANNEL REGION, CALIFORNIA, W70-00836 05B
BACTERIAL AND PROTOZOAN INDICATORS OF WATER POLLUTION - STATISTICAL AND EXPERIMENTAL APPROACH, W70-01036	05A	TEMPORAL, HORIZONTAL AND VERTICAL VARIABILITY OF WATER CHEMISTRY IN UNSATURATED ZONE OF FINE-GRAINED SOILS, W70-00911 05B
SWEETWATER POLLUTION, W70-01104	05B	STATUTORY STREAM POLLUTION CONTROL, W70-00923 05G
THE ENVIRONMENT--AND WHAT TO DO ABOUT IT, W70-01106	04D	CALCULATION OF WATER POLLUTION BY SURFACE RUNOFF, W70-01026 05B
STATEMENTS OF POLICY ON PUBLIC WATER SUPPLY MATTERS-- AMERICAN WATER WORKS ASS'N PRINCIPLES OF NATIONAL WATER POLICY, W70-01130	05G	STUDIES ON NATURAL FACTORS AFFECTING PHOSPHATE ABSORPTION AND ITS UTILIZATION BY ALGAE, W70-01031 05C
THE FEDERAL GOVERNMENT AND AIR AND WATER POLLUTION, W70-01136	05G	WATER POLLUTION TREATMENT MODIFIED FILTER MEDIA FROM REMOVAL OF WATER POLLUTANTS, W70-01027 05D
OBSTRUCTION AND POLLUTION OF WATERS. W70-01151	05G	WATER PURIFICATION ANALYSIS AND OPTIMIZATION OF A REVERSE OSMOSIS PURIFICATION SYSTEM--PART II. OPTIMIZATION, W70-00890 03A
DREDGING SAND AND GRAVEL AND MISCELLANEOUS OFFENSES (WATER POLLUTION) W70-01181	05G	WATER QUALITY WATER QUALITY AND REGIONAL ECONOMY, A DECISION MODEL, W70-00897 05G
WATER QUALITY CRITERIA FOR EUROPEAN FRESHWATER FISH REPORT ON WATER TEMPERATURE AND INLAND FISHERIES BASED MAINLY ON SLAVONIC LITERATURE. W70-01228	05C	THE DEVELOPMENT AND DISTRIBUTION OF PLANKTON IN THE NORTHERN PART OF THE WHITE NILE, W70-01007 02I
WATER POLLUTION CONTROL THE CONSTITUTIONAL ASPECTS OF WATER POLLUTION AND THE NEED FOR GOVERNMENTAL COOPERATION, W70-00915	05G	CALCULATION OF WATER POLLUTION BY SURFACE RUNOFF, W70-01026 05B
STATUTORY STREAM POLLUTION CONTROL, W70-00923	05G	THE CLASSIFICATION OF WATER QUALITY FROM THE BIOLOGICAL POINT OF VIEW, W70-01029 05A
W70-00924	05G	DILUTION OF WASTE EFFLUENTS IN WATERS (IN RUSSIAN), W70-01084 05G
W70-00925	05G	A GROUNDWATER QUALITY SUMMARY FOR ALASKA, W70-01087 04B
W70-00926	05G	GENERAL PROVISIONS OF THE STATE WATER CONTROL LAW. W70-01169 05G
WATER POLLUTION CONTROL AND ABATEMENT (BOOK REVIEW) CONTROLLING POLLUTION THE ECONOMICS OF A CLEANER AMERICA (BOOK REVIEW), W70-00933	05G	INCREASES IN MAXIMUM STREAM TEMPERATURES AFTER SLASH BURNING IN A SMALL EXPERIMENTAL WATERSHED, W70-01220 07C
CALCULATION OF WATER POLLUTION BY SURFACE RUNOFF, W70-01026	05B	WATER QUALITY CRITERIA FOR EUROPEAN FRESHWATER FISH REPORT ON WATER TEMPERATURE AND INLAND FISHERIES BASED MAINLY ON SLAVONIC LITERATURE. W70-01228 05C
MODIFIED FILTER MEDIA FROM REMOVAL OF WATER POLLUTANTS, W70-01027	05D	WATER QUALITY CLASSIFICATION THE CLASSIFICATION OF WATER QUALITY FROM THE BIOLOGICAL POINT OF VIEW, W70-01029 05A
THE USE OF A DIGITAL SIMULATION SYSTEM FOR THE MODELING AND PREDICTION OF WATER QUALITY, W70-01030	05A	WATER QUALITY CONTROL MATHEMATICAL SIMULATION OF THE ESTUARINE BEHAVIOR AND ITS APPLICATIONS, W70-00896 05C
COMPREHENSIVE WATER RESOURCES STUDIES ON THE ARA VALLEY AREA, JAPAN, W70-01034	05G	THE CLASSIFICATION OF WATER QUALITY FROM THE BIOLOGICAL POINT OF VIEW, W70-01029 05A
THE WATER QUALITY PROTECTION PLAN. EFFICIENT MEANS TO ASSURE RATIONAL USE IN HYDROGRAPHIC BASINS (FRENCH), W70-01038	05A	APPROACH TO DETERMINE THE MINIMUM ALLOWABLE FLOW IN THE TISZA RIVER, HUNGARY, W70-01035 05G
STATEMENTS OF POLICY ON PUBLIC WATER SUPPLY MATTERS-- AMERICAN WATER WORKS ASS'N PRINCIPLES OF NATIONAL WATER POLICY, W70-01130	05G	THE WATER QUALITY PROTECTION PLAN. EFFICIENT MEANS TO ASSURE RATIONAL USE IN HYDROGRAPHIC BASINS (FRENCH), W70-01038 05A
THE FEDERAL GOVERNMENT AND AIR AND WATER POLLUTION, W70-01136	05G	GENERAL PROVISIONS OF THE STATE WATER CONTROL LAW. W70-01169 05G
OFFENSES AGAINST PROPERTY BY FORCE. W70-01149	06E	POWERS AND DUTIES OF THE STATE WATER CONTROL BOARD. W70-01170 05G
OBSTRUCTION AND POLLUTION OF WATERS. W70-01151	05G	WATER QUALITY CRITERIA WATER QUALITY CRITERIA FOR EUROPEAN FRESHWATER FISH LIST OF LITERATURE ON THE EFFECT OF WATER TEMPERATURE ON FISH. W70-01227 05C
GENERAL PROVISIONS OF THE STATE WATER CONTROL LAW. W70-01169	05G	WATER QUALITY CRITERIA FOR EUROPEAN FRESHWATER FISH REPORT ON WATER TEMPERATURE AND INLAND FISHERIES BASED MAINLY ON SLAVONIC LITERATURE.
POWERS AND DUTIES OF THE STATE WATER CONTROL BOARD. W70-01170	05G	
PENALTIES FOR POLLUTION AND POLLUTION FROM BOATS. W70-01172	05G	
INTERSTATE COMMISSION ON THE POTOMAC RIVER BASIN. W70-01173	05G	

W70-01228	05C	EFFECT OF POLYELECTROLYTES IN CONJUNCTION WITH BENTONITIC CLAY ON CONTAMINANTS REMOVAL FROM SECONDARY EFFLUENTS, W70-00845 05D
WATER QUALITY MODEL THE WATER QUALITY PROTECTION PLAN. EFFICIENT MEANS TO ASSURE RATIONAL USE IN HYDROGRAPHIC BASINS (FRENCH), W70-01038	05A	WATER RIGHTS PRIVATE WATER RIGHTS IN FRANCE AND IN THE EASTERN UNITED STATES, W70-00919 06B
WATER REQUIREMENTS WATER RESOURCES AND THE CHEMICAL INDUSTRY IN NEW JERSEY AN ECONOMETRIC AND ENGINEERING ANALYSIS, W70-01217	06D	CONSTITUTIONAL LAW--COMMERCE CLAUSE--WATER RIGHTS IN THE FLOW OF A NON-NAVIGABLE STREAM ARE PROPERTY RIGHTS, W70-00922 04A
WATER RESOURCES ANNOTATED BIBLIOGRAPHY ON HYDROLOGY AND SEDIMENTATION, 1963-65, UNITED STATES AND CANADA, W70-00837	02J	FEDERAL REGULATION OF WATERWAYS, W70-00928 04A
STATE POLICY AS TO WATERS, W70-00984	06E	APPROPRIATION WATER LAW ELEMENTS IN RIPARIAN DOCTRINE STATES, W70-01134 06E
WATER RESOURCES, W70-01156	04B	ACQUISITION OF THE RIGHT TO USE WATER, W70-01137 06E
WATER RESOURCES DEVELOPMENT SIMULATION OF RUNOFF FOR DESIGN OF WATER RESOURCE SYSTEMS, W70-00900	04A	RIPARIAN WATER RIGHTS V A PRIOR APPROPRIATION SYSTEM A COMPARISON, W70-01139 06B
A STOCHASTIC APPROACH TO THE DEVELOPMENT OF A REGULATION PLAN FOR THE GREAT LAKES, W70-00902	02H	W70-01141 06B
APPLICATION OF DYNAMIC PROGRAMMING TO THE CONTROL OF WATER RESOURCES SYSTEMS, W70-00903	06A	WATER SHORTAGE OASES FOR THE FUTURE, W70-01203 06B
LOWER MISSISSIPPI RIVER BASIN DEVELOPMENT DISTRICT, W70-00912	04A	WATER STORAGE WATER-RETENTION CHARACTERISTICS OF COARSE ROCK PARTICLES, W70-00997 02G
GOVERNMENTAL TECHNIQUES FOR THE CONSERVATION AND UTILIZATION OF WATER RESOURCES AN ANALYSIS AND PROPOSAL, W70-00934	06B	THE VOLUME AND CHARACTER OF SILTING-SEDIMENTATION OF THE SIONI RESERVOIR (RUSSIAN), W70-01019 02J
W70-00935	06B	WATER SUPPLY VILLAGE WATER SUPPLY INVESTIGATION, TERRITORY OF PAPUA AND NEW GUINEA, W70-00991 03B
W70-00936	06B	RHODE ISLAND WATER RESOURCES BOARD, W70-01189 06D
TOMBIGBEE RIVER VALLEY WATER MANAGEMENT DISTRICT, W70-00955	04A	OASES FOR THE FUTURE, W70-01203 06B
W70-00956	04A	WATER TABLE AN INEXPENSIVE SHALLOW WATER TABLE PROBE, W70-00996 07B
W70-00957	04A	WATER TEMPERATURE WATER TEMPERATURE DURING THE MELTING OF LAKE ICE, W70-00852 02H
BIG BLACK RIVER BASIN DISTRICT, W70-00961	04A	SOME THERMAL CHARACTERISTICS OF TWO RIVERS IN THE PENNINE AREA OF NORTHERN ENGLAND, W70-00881 05B
W70-00962	04A	ADAPTATION OF AIR TEMPERATURE FIELD TO WATER TEMPERATURE FIELD (RUSSIAN), W70-01017 02A
W70-00963	04A	INCREASES IN MAXIMUM STREAM TEMPERATURES AFTER SLASH BURNING IN A SMALL EXPERIMENTAL WATERSHED, W70-01220 07C
VILLAGE WATER SUPPLY INVESTIGATION, TERRITORY OF PAPUA AND NEW GUINEA, W70-00991	03B	WATER QUALITY CRITERIA FOR EUROPEAN FRESHWATER FISH LIST OF LITERATURE ON THE EFFECT OF WATER TEMPERATURE ON FISH, W70-01227 05C
COMPREHENSIVE WATER RESOURCES STUDIES ON THE ARA VALLEY AREA, JAPAN, W70-01034	05G	WATER QUALITY CRITERIA FOR EUROPEAN FRESHWATER FISH REPORT ON WATER TEMPERATURE AND INLAND FISHERIES BASED MAINLY ON SLAVONIC LITERATURE, W70-01228 05C
THE WATER QUALITY PROTECTION PLAN. EFFICIENT MEANS TO ASSURE RATIONAL USE IN HYDROGRAPHIC BASINS (FRENCH), W70-01038	05A	WATER TRANSFER WATER SUPPLIES IN SOUTH AUSTRALIA, W70-01204 03B
STATEMENTS OF POLICY ON PUBLIC WATER SUPPLY MATTERS-- AMERICAN WATER WORKS ASS'N PRINCIPLES OF NATIONAL WATER POLICY, W70-01130	05G	WATER TUNNELS (CONVEYANCE) HYDRAULIC PROPERTIES OF SMALL UNLINED ROCK TUNNELS, W70-01115 08B
PEARL RIVER BASIN DEVELOPMENT DISTRICT ACT, W70-01157	06B	WATER USERS ACQUISITION OF THE RIGHT TO USE WATER, W70-01137 06E
W70-01158	06B	RIPARIAN WATERS RIGHTS V A PRIOR APPROPRIATION SYSTEM A COMPARISON, W70-01140 06B
PEARL RIVER BASIN DEVELOPMENT ACT, W70-01159	06B	WATER UTILIZATION BASIC CONCEPTS IN GROUND WATER LAW, W70-00914 04B
FEDERAL WATER RESOURCES DEVELOPMENT, W70-01179	06B	TOMBIGBEE RIVER VALLEY WATER MANAGEMENT DISTRICT, W70-00955 04A
RHODE ISLAND WATER RESOURCES BOARD, W70-01187	06D	W70-00956 04A
W70-01188	06D	W70-00957 04A
W70-01189	06D	WATER WELLS RECORDS OF SELECTED WELLS AND SPRINGS IN THE RULISON PROJECT AREA, GARFIELD AND MESA COUNTIES, COLORADO,
W70-01190	06D	
THE CHANGING ROLE OF WATER IN ARID LANDS, W70-01199	06B	
CASES FOR THE FUTURE, W70-01203	06B	
WATER SUPPLIES IN SOUTH AUSTRALIA, W70-01204	03B	
WATER RESOURCES PLANNING CANALS AND WATERWAYS (UPPER MISSISSIPPI RIVERWAY COMPACT), W70-00939	06B	
WATER REUSE		

WAT-ZIN

W70-00987

WATER WORKS

ROCKLAND COUNTY ANTI-RESERVOIR ASS'N V DURYEA (PREVENTION OF
RESERVOIR CONSTRUCTION).
W70-01147

07C

04A

WATER YIELD

A WATER YIELD MODEL DERIVED FROM MONTHLY RUNOFF DATA.
W70-00905

03B

WATER YIELD IMPROVEMENT

REGIONAL AND SEASONAL WATER SUPPLY IN THE TARIM BASIN AND
ITS RELATION TO CULTIVATED LAND POTENTIALS.
W70-01210

03F

WATERCOURSES

SALVAGE.
W70-00947

06E

WATERSHED MANAGEMENT

A WATER YIELD MODEL DERIVED FROM MONTHLY RUNOFF DATA.
W70-00905

03B

WATERSHEDS(BASINS)

GOVERNMENTAL TECHNIQUES FOR THE CONSERVATION AND UTILIZATION
OF WATER RESOURCES AN ANALYSIS AND PROPOSAL.
W70-00935

06B

W70-00936

06B

WESTPHAL V SCHMALZ (UNAUTHORIZED USE OF DRAINAGE SYSTEM).
W70-00971

04A

WATERSHEDS(DIVIDES)

CONDAMINATION BY CITIES AND COUNTIES TO PROVIDE WATERSHEDS OR
BEDS FOR WATER PIPES.
W70-00973

04A

WAVES(WATER)

PROPAGATION OF WAVE-FRONTS IN WIDE CHANNELS OF ARBITRARY
CROSS-SECTION,
W70-00872

08B

WAVE-FRONT PROPAGATION

PROPAGATION OF WAVE-FRONTS IN WIDE CHANNELS OF ARBITRARY
CROSS-SECTION,
W70-00872

08B

WEATHER FORECASTING

CONSTRUCTION OF A MULTILEVEL SCHEME STABLE IN RELATION TO
INITIAL DATA FOR SHORT-RANGE WEATHER FORECAST (RUSSIAN),
W70-01015

02B

WEATHER MODIFICATION

OPTIMIZATION TECHNIQUES IN WEATHER MODIFICATION,
W70-01122

03B

WEATHER PATTERNS

WEATHER PATTERNS IN SOUTHERN WEST PAKISTAN,
W70-01197

02B

WELDING

INCREASING THE CAVITATION RESISTANCE OF PARTS BY USING

SUBJECT INDEX

EXPLOSIVE-WELDED FACINGS,
W70-01127

08C

WELL CONSTRUCTION
OIL FIELDS YIELD NEW DEEP-WELL DISPOSAL TECHNIQUE,
W70-00990

05E

WELL REGULATIONS
WATER RESOURCES.
W70-01156

04B

WEST PAKISTAN
WEATHER PATTERNS IN SOUTHERN WEST PAKISTAN,
W70-01197

02B

WILDLIFE CONSERVATION
CLUBS, PRESERVES, AND NATIONAL FORESTS COMPLIMENTARY
LICENSES.
W70-01021

06E

WILDLIFE MANAGEMENT
CLUBS, PRESERVES, AND NATIONAL FORESTS COMPLIMENTARY
LICENSES.
W70-01021

06E

FISHING, HUNTING, TRAPPING PERMITS.
W70-01160

06E

WIND VELOCITY
NONLINEAR THEORY OF WIND DRIFT OF ICE (RUSSIAN),
W70-01018

02C

WINDS
AN ESTIMATION OF WIND EFFECTS ON DISPERSION IN WIDE
CHANNELS,
W70-00842

02E

WISCONSIN
THE DILEMMA OF WATER RECREATION AND A SUGGESTED SOLUTION,
W70-00930

06D

THE DILEMMA OF WATER RECREATION AND A SUGGESTED SOLUTION
(PART I),
W70-00931

06D

THE DILEMMA OF WATER RECREATION AND A SUGGESTED SOLUTION
(PART II),
W70-00932

06D

GOVERNMENTAL RESTRICTION OF WATER USE,
W70-00938

06D

WISCONSIN LAW OF WATERS,
W70-01138

04A

WITHDRAWAL
LAND SUBSIDENCE DUE TO GROUND-WATER WITHDRAWAL, TULARE-WASCO
AREA, CALIFORNIA,
W70-01013

02F

ZINOPHOS
PERSISTENCE OF DIAZINON AND ZINOPHOS IN SOIL EFFECTS OF
AUTOCLOAVING, TEMPERATURE, MOISTURE, AND ACIDITY,
W70-01079

02K

AUTHOR INDEX

ABDEL-HADY, M.			
SURFACE AND SUBSURFACE EXPLORATION BY INFRARED SURVEYS, W70-01128	07B		
ABU GIDFIRI, Y. B.			
THE DEVELOPMENT AND DISTRIBUTION OF PLANKTON IN THE NORTHERN PART OF THE WHITE NILE, W70-01007	02I		
ADAMS, WILLIAM M.			
A HYDROGEOPHYSICAL SURVEY FROM KAWAIAHE TO KAILUA-KONA, HAWAII, W70-00908	03B		
ADRIAN, DONALD D.			
A SYSTEMS APPROACH TO WASTE MANAGEMENT, W70-00898	05D		
AGARWAL, R. S.			
USE OF A SELECTIVE ION ELECTRODE FOR DETERMINATION OF NITRATE IN SOILS, W70-01075	05A		
AGARWAL, C. D.			
MODIFIED FILTER MEDIA FROM REMOVAL OF WATER POLLUTANTS, W70-01027	05D		
AITSAM, A. M.			
ABOUT THE QUESTION OF VERTICAL MIXING OF WASTE WATERS IN CLOSED RESERVOIRS (IN RUSSIAN), W70-01078	05B		
ALEXANDER, STUART E.			
CATAST SYSTEM CONTROLS FOR REGULATION OF COMBINED SEWAGE FLOWS, W70-00889	05D		
ALI, K. H. M.			
CONVERGENT STILLING BASINS, W70-01099	08B		
AMBERG, R. R.			
STREAM REAERATION USING MOLECULAR OXYGEN, W70-01028	05G		
AMIN, MUTHAKIL A.			
THE KHASHM EL GIRBA IRRIGATION SCHEME A NEW SOCIO-ECONOMIC PROJECT IN THE SUDAN, W70-01208	03F		
ANDERSON, D. O.			
A PHYSICAL AND ECONOMIC ANALYSIS OF ALTERNATIVE IRRIGATION METHODS IN A SUB-HUMID CLIMATE, W70-01086	03F		
ANDERSON, G. C.			
SEASONAL CHARACTERISTICS OF TWO SALINE LAKES IN WASHINGTON, W70-01076	02H		
SOME LIMNOLOGICAL FEATURES OF A SHALLOW SALINE MEROMICTIC LAKE, W70-01077	02H		
ANDERSON, J. S.			
SAMPLING AND ANALYSIS OF WASTE WATER FROM INDIVIDUAL HOMES (TASK 2), W70-01050	08B		
ANTONIUS, S.			
THE WATER QUALITY PROTECTION PLAN. EFFICIENT MEANS TO ASSURE RATIONAL USE IN HYDROGRAPHIC BASINS (FRENCH), W70-01038	05A		
BACK, P. A. A.			
THE SEISMIC DESIGN STUDY OF A DOUBLE CURVATURE ARCH DAM, W70-01094	08A		
BAILEY, ROBERT G.			
SOIL SLIPPAGE AN INDICATOR OF SLOPE INSTABILITY ON CHAPARRAL WATERSHEDS OF SOUTHERN CALIFORNIA, W70-01196	02J		
BAKER, J. M.			
RECOVERY OF A SALT MARSH IN PEMBROKESHIRE, SOUTH-WEST WALES, FROM POLLUTION BY CRUDE OIL, W70-01231	05C		
BAKLANOVSKAYA, V. F.			
ADAPTATION OF AIR TEMPERATURE FIELD TO WATER TEMPERATURE FIELD (RUSSIAN), W70-01017	02A		
BALDWIN, C. J.			
IMPROVED DIGITAL SIMULATION FOR ANALYZING POWER SYSTEM DISTURBANCES, W70-01105	08C		
BALLARD, J. A.			
A RAPID FOR MEASURING THE ACUTE TOXICITY OF DISSOLVED MATERIALS TO MARINE FISHES, W70-00849	05A		
BARA, J. P.			
CONTROLLING THE EXPANSION OF DESICCATED CLAYS DURING CONSTRUCTION, W70-01112	08D		
BARTKE, RICHARD W.			
THE NAVIGATION SERVITUDE AND JUST COMPENSATION STRUGGLE FOR A DOCTRINE, W70-01144	04A		
BAUFR, A.			
A PHYSICAL AND ECONOMIC ANALYSIS OF ALTERNATIVE IRRIGATION METHODS IN A SUB-HUMID CLIMATE, W70-01086	03F		
BAYH, BIRCH			
WATER POLLUTION CONTROL AND ABATEMENT (BOOK REVIEW) CONTROLLING POLLUTION THE ECONOMICS OF A CLEANER AMERICA (BOOK REVIEW), W70-00933	05G		
BEDER, B. A.			
A SCHEME OF GEOTHERMAL WATERS OF CENTRAL ASIA (RUSSIAN), W70-00869	02F		
BEHNKE, JEROLD J.			
AN EMPIRICAL METHOD FOR ESTIMATING MONTHLY POTENTIAL EVAPOTRANSPIRATION IN NEVADA, W70-01004	02D		
BELLEVUE, C.			
NON-LINEAR FREE SURFACES IN OPEN CHANNELS (FRENCH), W70-00871	08B		
BERGEN, JAMES D.			
NOCURNAL AIR TEMPERATURE ON A FORESTED MOUNTAIN SLOPE, W70-01219	02B		
BERGMAN, J. M.			
EFFECT OF RAINFALL VARIABILITY ON STREAMFLOW SIMULATION, W70-00850	02A		
BERNINGHAM, PAUL E.			
THE FEDERAL GOVERNMENT AND AIR AND WATER POLLUTION, W70-01136	05G		
BEUSCHER, J. H.			
APPROPRIATION WATER LAW ELEMENTS IN RIPARIAN DOCTRINE STATES, W70-01134	06E		
BLACK, A. P.			
BASIC CONCEPTS IN GROUND WATER LAW, W70-00914	04B		
BOLSENKA, S. J.			
TOTAL ALBEDO OF GREAT LAKES ICE, W70-00851	02C		
BORNANN, F. H.			
USE OF MEMBRANE FILTERS IN GRAVIMETRIC ANALYSES OF PARTICULATE MATTER IN NATURAL WATERS, W70-00857	07B		
BOUWER, HERMAN			
REVIEW OF METHODS FOR MEASURING AND PREDICTING SEEPAGE, W70-01238	04A		
BOWEN, ROBERT N.			
FINAL REPORT TO THE AMERICAN SOCIETY OF CIVIL ENGINEERS ON TASK 7 AND TASK 9 OF THE COMBINED SEWER SEPARATION PROJECT, W70-01043	08A		
BOWER, LEONARD G.			
PATTERNS OF WATER USE IN THE ARIZONA ECONOMY, W70-01202	06D		
BOYLE, C. L.			
OIL POLLUTION OF THE SEA IS THE END IN SIGHT, W70-01230	05C		
BRADFORD, B. N.			
FACTORS AFFECTING THE GROWTH OF NAJAS IN PICKWICK RESERVOIR, W70-01071	05C		
BREMNER, J. M.			
USE OF A SELECTIVE ION ELECTRODE FOR DETERMINATION OF NITRATE IN SOILS, W70-01075	05A		
BRESLER, E.			
A NUMERIC METHOD FOR ESTIMATING INFILTRATION, REDISTRIBUTION, DRAINAGE, AND EVAPORATION OF WATER FROM SOIL, W70-00862	02G		
BRETZ, J. HARLEN			
THE LAKE MISSOURIA FLOODS AND THE CHANNELLED SCABLAND, W70-01012	02J		
BROCKWAY, C. E.			
FIELD EVALUATION OF SEEPAGE MEASUREMENT METHODS, W70-01236	04A		
BROWN, K. W.			
COMPUTER PROGRAM FOR PLOTTING TIME DEPENDENT DATA WITH INSTRUCTION AND EXAMPLES, W70-01008	07C		
BROWN, R. E.			

BRUNGS, WILLIAM A. CHRONIC TOXICITY OF ZINC TO THE FATHEAD MINNOW, <i>PIMEPHALES PROMELAS RAFINESQUE</i> , W70-01229	05C	CHARACTERISTIC PRESSURE DISTRIBUTION IN OUTLET WORKS INLETS, W70-01222	08B
BUGLIARELLO, G. EVALUATION OF BENEFITS OF A FLOOD WARNING SYSTEM, W70-00838	06B	CRABB, PETER WATER SUPPLIES IN SOUTH AUSTRALIA, W70-01204	03B
BUNDY, L. G. USE OF A SELECTIVE ION ELECTRODE FOR DETERMINATION OF NITRATE IN SOILS, W70-01075	05A	CRABB, P. COMMUNITY IRRIGATION PROJECTS IN THE WAIKERIE DISTRICT OF SOUTH AUSTRALIA, W70-01207	03F
BURAS, NATHAN AQUEDUCT ROUTE OPTIMIZATION BY DYNAMIC PROGRAMMING, W70-00894	04A	CRAFT, THOMAS FISHER, JR. RADIOTRACER STUDY OF RAPID SAND FILTRATION, W70-00910	05D
A CONJUNCTIVE OPERATION OF A SURFACE RESERVOIR AND A GROUNDWATER AQUIFER. W70-00906	02A	CRAPPER, G. D. PROPAGATION OF WAVE-FRONTS IN WIDE CHANNELS OF ARBITRARY CROSS-SECTION, W70-00872	08B
BYERLY, R. T. IMPROVED DIGITAL SIMULATION FOR ANALYZING POWER SYSTEM DISTURBANCES, W70-01105	08C	CULLEY, DUDLEY D. PATTERNS OF INSECTICIDE RESISTANCE IN THE MOSQUITOFISH, <i>GAMBUSIA AFFINIS</i> , W70-01226	05C
CARR, P. A. DETERMINING AQUIFER CHARACTERISTICS BY THE TIDAL METHOD, W70-00859	02F	DANEKER, JAMES R. CONTROL TECHNIQUES FOR PRESSURIZED SEWERAGE SYSTEMS, W70-01064	08C
CARSTEAD, D. D. FORMATION OF HYDROXY-AL AND -FE INTERLAYERS IN MONTMORILLONITE AND VERMICULITE INFLUENCE OF PARTICLE SIZE AND TEMPERATURE, W70-01014	02K	DARLEY, H. C. H. A LABORATORY INVESTIGATION OF BOREHOLE STABILITY, W70-01107	08E
CASSELL, A. C. THE SEISMIC DESIGN STUDY OF A DOUBLE CURVATURE ARCH DAM, W70-01094	08A	DAVIS, STANLEY N. WATER-RETENTION CHARACTERISTICS OF COARSE ROCK PARTICLES, W70-00997	02G
CAVADIAS, G. S. A STOCHASTIC APPROACH TO THE DEVELOPMENT OF A REGULATION PLAN FOR THE GREAT LAKES, W70-00902	02H	DAWDY, D. R. EFFECT OF RAINFALL VARIABILITY ON STREAMFLOW SIMULATION, W70-00850	02A
CHAMPLIN, JERRY E. F. THE RELATION OF ION MOVEMENT TO FINE PARTICLE DISPLACEMENT IN A SAND BED, W70-00909	05B	DAY, H. J. EVALUATION OF BENEFITS OF A FLOOD WARNING SYSTEM, W70-00838	06B
CHANAY, DONALD EUGENE NAVIGABLE WATER--ARTIFICIAL LAKE CONNECTED TO RIVER, W70-00937	04A	DE BREUCK, W. THE WATER-TABLE AQUIFER IN THE EASTERN COASTAL AREA OF BELGIUM, W70-00986	02F
CHEFFINS, O. W. PHOTOGRAMMETRIC MEASUREMENT OF ROCK SURFACES IN A POWER TUNNEL, W70-01090	07B	DE MOOR, G. THE WATER-TABLE AQUIFER IN THE EASTERN COASTAL AREA OF BELGIUM, W70-00986	02F
CHENG, C. Y. ANALYSIS AND OPTIMIZATION OF A REVERSE OSMOSIS PURIFICATION SYSTEM--PART II. OPTIMIZATION, W70-00890	03A	DEININGER, ROLF A. LINEAR PROGRAMMING FOR HYDROLOGIC ANALYSES, W70-00999	02A
CHOW, VEN TE A LABORATORY STUDY OF SURFACE RUNOFF DUE TO MOVING RAINSTORMS, W70-00839	02A	DELAINE, R. J. MEASURING RAINFALL ON FOREST CATCHMENTS, W70-00843	02B
SPATIALLY VARIED FLOW EQUATIONS, W70-01003	02E	DEROOGY, J. WATER RESOURCES AND THE CHEMICAL INDUSTRY IN NEW JERSEY AN ECONOMETRIC AND ENGINEERING ANALYSIS, W70-01217	06D
CHU, YEN H. CHARACTERISTIC PRESSURE DISTRIBUTION IN OUTLET WORKS INLETS, W70-01222	08B	DILS, ROBERT E. CHALLENGES TO CREATIVE CONSERVATION, W70-01081	06G
CLARK, R. H. A STOCHASTIC APPROACH TO THE DEVELOPMENT OF A REGULATION PLAN FOR THE GREAT LAKES, W70-00902	02H	DOMENICO, P. A. VALUATION OF A GROUNDWATER SUPPLY FOR MANAGEMENT AND DEVELOPMENT, W70-00904	04B
COANTIC, M. A STUDY OF HOT WIRE AND HOT FILM ANEMOMETERS IN WATER (FRENCH), W70-00868	07B	DRAGOUN, FRANK J. EFFECTS OF CULTIVATION AND GRASS ON SURFACE RUNOFF, W70-00863	04A
CONDON, R. W. ESTIMATION OF GRAZING CAPACITY ON ARID GRAZING LANDS, W70-01206	03F	DUCKSTEIN, LUCIEN GENERAL SYSTEMS APPROACH TO GROUND-WATER PROBLEMS, W70-01123	02F
CORLETT, R. F. NUCLEAR POWER PLANT SITING IN THE PACIFIC NORTHWEST FOR THE BONNEVILLE POWER ADMINISTRATION, W70-00883	05D	DUNGAR, R. THE SEISMIC DESIGN STUDY OF A DOUBLE CURVATURE ARCH DAM, W70-01094	08A
COWELL, E. B. RECOVERY OF A SALT MARSH IN PEMBROKESHIRE, SOUTH-WEST WALES, FROM POLLUTION BY CRUDE OIL, W70-01231	05C	DUNIN-BARKOVSKIY, L. V. THE WATER PROBLEM IN THE DESERTS OF THE USSR, W70-01215	03B
COX, D. E. PHOTOGRAMMETRIC MEASUREMENT OF ROCK SURFACES IN A POWER TUNNEL, W70-01090	07B	DUNIN, F. X. A MODEL FOR RAINFALL ROUTING DURING INITIAL ABSTRACTION, W70-00844	02A
COX, ROBERT G.		DUNLAP, WILLIAM J. MOVEMENT OF DDT AND NITRATES DURING GROUND-WATER RECHARGE, W70-00861	05B
		DUTTA, M. WATER RESOURCES AND THE CHEMICAL INDUSTRY IN NEW JERSEY AN ECONOMETRIC AND ENGINEERING ANALYSIS, W70-01217	06D
		EATON, JOHN S. USE OF MEMBRANE FILTERS IN GRAVIMETRIC ANALYSES OF PARTICULATE MATTER IN NATURAL WATERS, W70-00857	07B

AUTHOR	INDEX	ECK-HAR
ECKEL, O.		
NEW THERMAL INVESTIGATION OF LAKES TRAUHSEE AND FUSCHLSEE (IN GERMAN), W70-00886	02H	
EIDEL'MAN, S. IA.		
CRACKS IN BLOCKS OF THE BRATSK HYDROELECTRIC STATION DAM, W70-01119	08F	
EL BOUSHI, ISMAIL M.		
WATER-RETENTION CHARACTERISTICS OF COARSE ROCK PARTICLES, W70-00997	02G	
ELLIOTT, LOUIS		
COOLING TOWERS FOR STEAM-ELECTRIC STATIONS - ECONOMIC APPLICATIONS, W70-00887	05D	
ELSAHRIGI, AHMED F.		
THE OPTIMUM TEMPERATURE FOR THE OPERATION OF A NON-SCALING MULTI-STAGE FLASH EVAPORATOR PLANT, W70-00907	03A	
EMERSON, R. L.		
RECORDS OF SELECTED WELLS AND SPRINGS IN THE RULISON PROJECT AREA, GARFIELD AND MESA COUNTIES, COLORADO, W70-00987	07C	
ENGLAND, C. B.		
DIGITIZED PHYSICAL DATA OF A RANGELAND WATERSHED, W70-00993	07C	
ERICKSON, L. E.		
ANALYSIS AND OPTIMIZATION OF A REVERSE OSMOSIS PURIFICATION SYSTEM--PART II. OPTIMIZATION, W70-00890	03A	
FAM, L. T.		
ANALYSIS AND OPTIMIZATION OF A REVERSE OSMOSIS PURIFICATION SYSTEM--PART II. OPTIMIZATION, W70-00890	03A	
OPTIMIZATION OF THE ACTIVATED SLUDGE PROCESS-OPTIMUM VOLUME RATIO OF AERATION AND SEDIMENTATION VESSELS, W70-00893	05D	
FARRELL, R. PAUL		
ADVANCED DEVELOPMENT OF HOUSEHOLD PUMP-STORAGE-GRINDER UNIT (TASK 6), W70-01048	08C	
LONG-TERM OPERATION OF WASTEWATER OBSERVATION STATIONS (TASK 2), W70-01049	08B	
FARRELL, R. P.		
SAMPLING AND ANALYSIS OF WASTE WATER FROM INDIVIDUAL HOMES (TASK 2), W70-01050	08B	
FAY, A.		
DETECTION OF CAVITATION BY ACOUSTIC AND VIBRATION- MEASUREMENT METHODS, W70-00875	08B	
FERGUSON, D. E.		
PATTERNS OF INSECTICIDE RESISTANCE IN THE MOSQUITOFISH, GAMBUSIA AFFinis, W70-01226	05C	
FLETCHER, BOBBY P.		
SPILLWAY FOR REND LAKE RESERVOIR, BIG MUDDY RIVER, ILLINOIS HYDRAULIC MODEL INVESTIGATION, W70-01223	08B	
FLISOWSKI, JAN		
ROLE OF PROGNOSIS OF GROUNDWATER STATE IN PROJECTION OF DAMS (POLISH), W70-00874	08A	
FORSTER, WILLIAM O.		
MEASUREMENT OF COLUMBIA RIVER FLOW TIME FROM HANFORD REACTORS TO ASTORIA, OREGON-SUMMER 1966, W70-01002	02E	
FRAZEL, WILLIAM H.		
CONTROL TECHNIQUES FOR PRESSURIZED SEWERAGE SYSTEMS, W70-01064	08C	
FREDERIKSEN, HARALD D.		
DESIGN OF CALIFORNIA AQUEDUCT, W70-01111	08A	
FRUMAN, D.		
NON-LINEAR FREE SURFACES IN OPEN CHANNELS (FRENCH), W70-00871	08B	
GASANOVA, R. D.		
ADAPTATION OF AIR TEMPERATURE FIELD TO WATER TEMPERATURE FIELD (RUSSIAN), W70-01017	02A	
GATILLO, P. D.		
CALCULATION OF WATER POLLUTION BY SURFACE RUNOFF, W70-01026	05B	
GEL'MAN, A. S.		
INCREASING THE CAVITATION RESISTANCE OF PARTS BY USING EXPLOSIVE-WELDED FACINGS, W70-01127	08C	
GENDEL, ABRAHAM		
THE OPTIMUM TEMPERATURE FOR THE OPERATION OF A NON-SCALING MULTI-STAGE FLASH EVAPORATOR PLANT, W70-00907	03A	
GETZIN, L. W.		
PERSISTENCE OF DIAZINON AND ZINOPHOS IN SOIL EFFECTS OF AUTOCLOVING, TEMPERATURE, MOISTURE, AND ACIDITY, W70-01079	02K	
GIBBS, CHARLES V.		
CATAST SYSTEM CONTROLS FOR REGULATION OF COMBINED SEWAGE FLOWS, W70-00889	05D	
GIGLIO, RICHARD J.		
A SYSTEMS APPROACH TO WASTE MANAGEMENT, W70-00898	05D	
GLANDER, HARTMUT		
ON THE PRESENT OPTIMUM VARIANT IN HYDROGEOLOGICAL EXPLORATION (GERMAN), W70-01022	07C	
GLINSKIY, N. T.		
ADAPTATION OF AIR TEMPERATURE FIELD TO WATER TEMPERATURE FIELD (RUSSIAN), W70-01017	02A	
GORDON, BARBARA		
RIPARIAN WATER RIGHTS V A PRIOR APPROPRIATION SYSTEM A COMPARISON, W70-01139	06B	
RIPARIAN WATERS RIGHTS V A PRIOR APPROPRIATION SYSTEM A COMPARISON, W70-01140	06B	
RIPARIAN WATER RIGHTS V A PRIOR APPROPRIATION SYSTEM A COMPARISON, W70-01141	06B	
RIPARIAN WATER RIGHTS V A PRIOR APPROPRIATION SYSTEM A COMPARISON, W70-01142	06B	
GRACE, JOHN L.		
SPILLWAY FOR REND LAKE RESERVOIR, BIG MUDDY RIVER, ILLINOIS HYDRAULIC MODEL INVESTIGATION, W70-01223	08B	
GRANSTRÖM, H. L.		
WATER RESOURCES AND THE CHEMICAL INDUSTRY IN NEW JERSEY AN ECONOMETRIC AND ENGINEERING ANALYSIS, W70-01217	06D	
GRIFFITH, W. A.		
ESTIMATES OF PERIPHYTE MASS AND STREAM BOTTOM AREA USING PHOSPHORUS-32, W70-00846	02I	
HAAR, CHARLES B.		
RIPARIAN WATER RIGHTS V A PRIOR APPROPRIATION SYSTEM A COMPARISON, W70-01139	06B	
RIPARIAN WATERS RIGHTS V A PRIOR APPROPRIATION SYSTEM A COMPARISON, W70-01140	06B	
RIPARIAN WATER RIGHTS V A PRIOR APPROPRIATION SYSTEM A COMPARISON, W70-01141	06B	
RIPARIAN WATER RIGHTS V A PRIOR APPROPRIATION SYSTEM A COMPARISON, W70-01142	06B	
HALLMARK, DAISEL E.		
STUDY OF APPROXIMATE LENGTHS AND SIZES OF COMBINED SEWERS IN MAJOR METROPOLITAN CENTERS, W70-01057	08A	
HAMILTON, R. M.		
GEOLGY, PETROLEUM DEVELOPMENT, AND SEISMICITY OF THE SANTA BARBARA CHANNEL REGION, CALIFORNIA, W70-00836	05B	
HANKE, STEVE H.		
DYNAMIC ASPECTS OF URBAN WATER DEMAND, W70-00899	06D	
HANKS, R. J.		
A NUMERIC METHOD FOR ESTIMATING INFILTRATION, REDISTRIBUTION, DRAINAGE, AND EVAPORATION OF WATER FROM SOIL, W70-00862	02G	
HANSON, PETER J.		
MEASUREMENT OF COLUMBIA RIVER FLOW TIME FROM HANFORD REACTORS TO ASTORIA, OREGON-SUMMER 1966, W70-01002	02E	
HARTMANN, LUDWIG		
PHYSICAL AND BIOCHEMICAL ASPECTS OF BOD KINETICS, W70-01024	05C	
HARTMAN, CHARLES W.		
A WATER DISTRIBUTION SYSTEM FOR COLD REGIONS, THE SINGLE MAIN RECIRCULATING METHOD. AN HISTORICAL REVIEW, FIELD EVALUATION, AND SUGGESTED DESIGN PROCEDURES, W70-01088	04A	
HARTY, H.		

NUCLEAR POWER PLANT SITING IN THE PACIFIC NORTHWEST FOR THE BONNEVILLE POWER ADMINISTRATION, W70-00883	05D	JENSEN, ARNE STUDIES ON ALGAL SUBSTANCES IN THE SEA. II. THE FORMATION OF GELBSTOFF (HUMIC MATERIAL) BY EXUDATES OF PHALOPHYTA, W70-01072	05B
HAVENS, JOHN G. FINAL REPORT TO THE AMERICAN SOCIETY OF CIVIL ENGINEERS ON TASK 7 AND TASK 9 OF THE COMBINED SEWER SEPARATION PROJECT, W70-01043	08A	STUDIES ON ALGAL SUBSTANCES IN THE SEA. I. GELBSTOFF (HUMIC MATERIAL) IN TERRESTRIAL AND MARINE WATERS, W70-01074	05B
HAWKINS, RICHARD H. EFFECT OF CHANGES OF STREAMFLOW REGIMEN ON RESERVOIR YIELD, W70-01001	04A	JOHNSON, G. A. A PHYSICAL AND ECONOMIC ANALYSIS OF ALTERNATIVE IRRIGATION METHODS IN A SUB-HUMID CLIMATE, W70-01086	03F
HENDRICKSON, JOHN G. STUDY OF APPROXIMATE LENGTHS AND SIZES OF COMBINED SEWERS IN MAJOR METROPOLITAN CENTERS, W70-01057	08A	JOHNSON, PHILLIP R. A GROUNDWATER QUALITY SUMMARY FOR ALASKA, W70-01087	04B
HEBERT, ROBIN TIME VARIANT GROUND WATER FLOW BY RESISTANCE NETWORK ANALOGUES, W70-01039	02F	JOVANOVIC, SLAVOLJUB OPTIMIZATION OF THE LONG-TERM OPERATION OF A SINGLE-PURPOSE RESERVOIR, W70-00901	03B
HICKMAN, KENNETH OASES FOR THE FUTURE, W70-01203	06B	KADYSHNIKOV, V. M. CONSTRUCTION OF A MULTILEVEL SCHEME STABLE IN RELATION TO INITIAL DATA FOR SHORT-RANGE WEATHER FORECAST (RUSSIAN), W70-01015	02B
HILLEFORS, AKE GLACIAL HISTORY AND MORPHOLOGY OF WEST SWEDEN (SWEDISH), W70-00998	02C	KALNINA, Z. STRONTIUM-90 CONCENTRATION FACTORS OF LAKE PLANKTON, MACROPHYTES, AND SUBSTRATES, W70-01010	05C
HOBBS, M. FLOYD RELATIONSHIP OF SEWAGE CHARACTERISTICS TO CARRYING VELOCITY FOR PRESSURE SEWERS, W70-01047	08B	KAMENEV, S. P. ESTIMATION OF CLAY CONTENT OF SAND FORMATIONS FROM WELL- LOGGING DATA (RUSSIAN), W70-00887	07B
HIGHWAY MINIMUM TRANSPORT VELOCITY FOR PRESSURIZED SANITARY SEWERS, W70-01060	08B	KAMINSKY, FRANK C. A SYSTEMS APPROACH TO WASTE MANAGEMENT, W70-00898	05D
HOCK, BFLA APPROACH TO DETERMINE THE MINIMUM ALLOWABLE FLOW IN THE TISZA RIVER, HUNGARY, W70-01035	05G	KANNEBERG, ADOLF WISCONSIN LAW OF WATERS, W70-01138	04A
HOLZ, ROBERT K. THE ASWAN HIGH DAM, W70-01201	06B	KASHEP, ABDEL-AZIZ I. GROUNDWATER MOVEMENT TOWARD ARTIFICIAL CUTS, W70-00858	02F
HOPPE, T. C. COPING WITH COOLING TOWER BLOWDOWN, W70-00884	05D	KAZIENKO, HENRY J. DEVELOP AND FIELD TEST METHOD OF INSTALLING PRESSURE CONDUITS IN COMBINED SEWERS, W70-01044	08A
HORNER, JAMES M. UPLIFT RESISTANCE OF ANCHOR BAR, AUGER AND PRESSED PLATE FOOTINGS IN SANDY SILT, W70-01096	08C	KECKLER, WILLIAM G. APPLICATION OF DYNAMIC PROGRAMMING TO THE CONTROL OF WATER RESOURCES SYSTEMS, W70-00903	06A
HOUGHTON, V. T. EVALUATION OF BENEFITS OF A FLOOD WARNING SYSTEM, W70-00838	06B	KEELEY, JACK W. MOVEMENT OF DDT AND NITRATES DURING GROUND-WATER RECHARGE, W70-00861	05B
HO, L. Y. S. ANALYSIS AND OPTIMIZATION OF A REVERSE OSMOSIS PURIFICATION SYSTEM--PART II. OPTIMIZATION, W70-00890	03A	KENNEDY, H. G. FACTORS AFFECTING THE GROWTH OF MAJAS IN PICKWICK RESERVOIR, W70-01071	05C
HO, P. H. P. EVALUATION OF BENEFITS OF A FLOOD WARNING SYSTEM, W70-00838	06B	KENNEDY, VANCE C. FLUORESCENT SAND AS A TRACER OF FLUVIAL SEDIMENT, W70-00867	02J
HUBER, CHARLES N. GOVERNMENTAL RESTRICTION OF WATER USE, W70-00938	06D	KEVERN, H. R. ESTIMATES OF PERiphyton MASS AND STREAM BOTTOM AREA USING PHOSPHOROUS-32, W70-00846	02I
HURR, THEODORE R. RECORDS OF SELECTED WELLS AND SPRINGS IN THE BULISON PROJECT AREA, GARFIELD AND MESA COUNTIES, COLORADO, W70-00987	07C	KIM, STEVE W. A GROUNDWATER QUALITY SUMMARY FOR ALASKA, W70-01087	04B
HUVAL, CARL J. HYDRAULIC DESIGN OF UNLINED ROCK TUNNELS, W70-01114	08E	KIRILLOV, V. I. ON THE POSSIBILITY OF ESTIMATING THE THICKNESS OF UNCONSOLIDATED ROCKS BY VERTICAL ELECTRICAL SOUNDING IN PERmafrost AREAS (RUSSIAN), W70-00878	07B
HWANG, C. L. ANALYSIS AND OPTIMIZATION OF A REVERSE OSMOSIS PURIFICATION SYSTEM--PART II. OPTIMIZATION, W70-00890	03A	KIRKHAM, DON STEADY FLOW OF WATER THROUGH A TWO-LAYER SOIL, W70-00840	02G
IMHOFF, KLAUS R. OXYGEN MANAGEMENT AND ARTIFICIAL REAERATION IN THE AREA OF BALDENBY LAKE AND THE LOWER BUHR RIVER (IN GERMAN), W70-01224	05G	KISIEL, CHESTER C. GENERAL SYSTEMS APPROACH TO GROUND-WATER PROBLEMS, W70-01123	02F
JAMES, W. R. FREQUENCY DISTRIBUTIONS OF STREAM LINK LENGTHS, W70-01006	02J	KLAUSING, R. L. LAND SUBSIDENCE DUE TO GROUND-WATER WITHDRAWAL, TULARE-WASCO AREA, CALIFORNIA, W70-01013	02F
JAMISON, D. G. SUBSURFACE FLOW REGIMES OF A HYDROLOGIC WATERSHED MODEL, W70-01237	02F	KLUETE, A. A NUMERIC METHOD FOR ESTIMATING INFILTRATION, REDISTRIBUTION, DRAINAGE, AND EVAPORATION OF WATER FROM SOIL, W70-00862	02G
JASKE, R. T. THE USE OF A DIGITAL SIMULATION SYSTEM FOR THE MODELING AND PREDICTION OF WATER QUALITY, W70-01030	05A	KNOWLES, G. THE PREDICTION OF THE DISTRIBUTION OF DISSOLVED OXYGEN IN RIVERS, W70-01033	05B
JEGLIC, J. M. MATHEMATICAL SIMULATION OF THE ESTUARINE BEHAVIOR AND ITS APPLICATIONS, W70-00896	05C		

AUTHOR	INDEX	KOM-MIT
KOMAROV, V. S. STATISTICAL STRUCTURE OF VERTICAL HUMIDITY PROFILES (RUSSIAN), W70-01016	02B	
KONAR, S. K. FISHERY MANAGEMENT WITH THE HELP OF THE ORGANOPHOSPHORUS INSECTICIDE, THIOMETON, W70-01232	05C	
KOS, IING ZDENEK SIMULATION OF RUNOFF FOR DESIGN OF WATER RESOURCE SYSTEMS, W70-00900	04A	
KOUBA, DOROTHY L. FLUORESCENT SAND AS A TRACER OF FLUVIAL SEDIMENT, W70-00867	02J	
KRAHENBUHL, H. R. STATISTICAL CHARACTERIZATION OF MIXTURES OF HYDROCARBONS, W70-01025	05A	
KRUMBELIN, W. C. FREQUENCY DISTRIBUTIONS OF STREAM LINK LENGTHS, W70-01006	02J	
KUNIN, V. N. THE STUDY OF LOCAL WATERS IN THE DESERTS OF THE USSR, W70-01216	03B	
KUVAYEV, O. M. ON THE POSSIBILITY OF ESTIMATING THE THICKNESS OF UNCONSOLIDATED ROCKS BY VERTICAL ELECTRICAL SOUNDING IN PERmafrost AREAS (RUSSIAN), W70-00878	07B	
LAJTAI, E. Z. STRENGTH OF DISCONTINUOUS ROCKS IN DIRECT SHEAR, W70-01101	08E	
LANDSPERG, H. E. CITY AIR - BETTER OR WORSE, W70-01239	05B	
LARSEN, PETER A. HEAD LOSSES CAUSED BY AN ICE COVER ON OPEN CHANNELS, W70-01126	08B	
LARSON, ROBERT E. APPLICATION OF DYNAMIC PROGRAMMING TO THE CONTROL OF WATER RESOURCES SYSTEMS, W70-00903	06A	
LAYKHTMAN, D. L. NONLINEAR THEORY OF WIND DRIFT OF ICE (RUSSIAN), W70-01018	02C	
LEBON, J. H. G. THE LAND AND WATER USE SURVEY OF NORTH-CENTRAL KORDOFAN (1961-66), W70-01198	03B	
LEchner, H. BACTERIAL AND PROTOZOAN INDICATORS OF WATER POLLUTION - STATISTICAL AND EXPERIMENTAL APPROACH, W70-01036	05A	
LEPLEY, LARRY K. A HYDROGEOPHYSICAL SURVEY FROM KAWAIHAE TO KAILUA-KONA, HAWAII, W70-00908	03B	
LEVI, I. I. NEW PROBLEMS IN THE THEORY OF BOTTOM CURRENTS IN RESERVOIRS, W70-01129	08B	
LEVNO, AL INCREASES IN MAXIMUM STREAM TEMPERATURES AFTER SLASH BURNING IN A SMALL EXPERIMENTAL WATERSHED, W70-01220	07C	
LEWIS, R. E. GROUNDWATER IN SANTA BARBARA COUNTY, CALIFORNIA, SPRING 1967 TO SPRING 1968, W70-00969	07C	
LIBBY, FRED AN INEXPENSIVE SHALLOW WATER TABLE PROBE, W70-00996	07B	
LIKENS, GENE E. USE OF MEMBRANE FILTERS IN GRAVIMETRIC ANALYSES OF PARTICULATE MATTER IN NATURAL WATERS, W70-00857	07B	
LITVINOV, V. P. ON THE HYDROGEOLOGY OF THE CENTRAL AND NORTHWESTERN PART OF THE DNIPPER-DONETS ARTESIAN BASIN (UKRAINIAN), W70-00866	02K	
LLOYD, R. THE DIURETIC RESPONSE BY RAINBOW TROUT TO SUB-LETHAL CONCENTRATIONS OF AMMONIA, W70-00848	05C	
LOFGREN, B. E. LAND SUBLIMATION DUE TO GROUND-WATER WITHDRAWAL, TULARE-WASCO		
AREA, CALIFORNIA, W70-01013	02F	
LONG, GILLIS W. CIVIL LAW PROPERTY--ENCROACHMENTS ON RIVER BANKS BY RIPARIAN OWNERS, W70-01135	04C	
LOUCKS, DANIEL P. STOCHASTIC METHODS FOR ANALYZING RIVER BASIN SYSTEMS, W70-01085	06A	
LYSYJ, I. APPLICATION OF PYROLYtic GAS CHROMATOGRAPHY TO NATURAL WATERS, W70-00847	05A	
MACGREGOR, J. P. VILLAGE WATER SUPPLY INVESTIGATION, TERRITORY OF PAPUA AND NEW GUINEA, W70-00991	03B	
MACLEOD, LESTER H. THE OPTIMUM TEMPERATURE FOR THE OPERATION OF A NON-SCALING MULTI-STAGE FLASH EVAPORATOR PLANT, W70-00907	03A	
MARTIN, J. B., JR. FACTORS AFFECTING THE GROWTH OF MAJAS IN PICKWICK RESERVOIR, W70-01071	05C	
MARTIN, WILLIAM E. THE ECONOMICS OF ARIZONA'S WATER PROBLEM, W70-01200	06D	
PATTERNS OF WATER USE IN THE ARIZONA ECONOMY, W70-01202	06D	
MATALUCCI, R. V. SURFACE AND SUBSURFACE EXPLORATION BY INFRARED SURVEYS, W70-01128	07B	
MATHUR, SURENDRA P. A HYDROGEOPHYSICAL SURVEY FROM KAWAIHAE TO KAILUA-KONA, HAWAII, W70-00908	03B	
MAUGERI, JAMES WATER QUALITY AND REGIONAL ECONOMY, A DECISION MODEL, W70-00897	05G	
MAXEY, GEORGE B. AN EMPIRICAL METHOD FOR ESTIMATING MONTHLY POTENTIAL EVAPOTRANSPIRATION IN NEVADA, W70-01004	02D	
MCCONNELL, WILLIAM J. LIMNOLOGICAL EFFECTS OF ORGANIC EXTRACTS OF LITTER IN A SOUTHWESTERN IMPOUNDMENT, W70-01080	02H	
MCCULLOH, T. H. GEOLOGY, PETROLEUM DEVELOPMENT, AND SEISMICITY OF THE SANTA BARBARA CHANNEL REGION, CALIFORNIA, W70-00836	05B	
MCGUINNESS, J. L. SEASONAL VARIATION IN RAIN GAGE CATCH, W70-00854	02B	
MCKINLEY, KEITH HAS RECENT LEGISLATION LIMITED PRIVATE RIPARIAN RIGHTS IN IOWA, W70-01133	03D	
MCMILLION, LESLIE G. MOVEMENT OF DDT AND NITRATES DURING GROUND-WATER RECHARGE, W70-00861	05B	
MCPHERSON, MURRAY B. MINIMUM TRANSPORT VELOCITY FOR PRESSURIZED SANITARY SEWERS, W70-01060	08B	
DOMESTIC SEWAGE FLOW CRITERIA FOR EVALUATION OF PROJECT SCHEME TO ACTUAL COMBINED SEWER DRAINAGE AREAS, W70-01061	08B	
MEL'NIKOV, D. A. THE RELATIONSHIP BETWEEN THE ULTIMATE RESISTIVITY OF CLAYEY SANDSTONES AND THEIR POROSITY AND CLAY CONTENTS (RUSSIAN), W70-00876	07B	
METREBELLI, G. S. THE VOLUME AND CHARACTER OF SILTING-SEDIMENTATION OF THE SIONI RESERVOIR (RUSSIAN), W70-01019	02J	
MILES, ROBERT D. MULTISENSOR ANALYSIS FOR SOILS MAPPING, W70-01125	07B	
MILLER, GARY W. A LIMNOLOGICAL COMPARISON OF TWO SMALL IDAHO RESERVOIRS, W70-01005	02H	
MIRATA, T. A SEMI-EMPIRICAL METHOD FOR DETERMINING STRESSES BENEATH EMBANKMENTS, W70-01102	08D	
MITCHELL, J. M., JR.		

THE THERMAL CLIMATE OF CITIES, W70-01241	05B	THE PREDICTION OF THE DISTRIBUTION OF DISSOLVED OXYGEN IN RIVERS, W70-01033	05B
MONRO, JOHN C. CONTINUOUS HYDROGRAPH SYNTHESIS WITH AN API-TYPE HYDROLOGIC MODEL, W70-00860	02A	PALMER, L. L. ABOUT THE QUESTION OF VERTICAL MIXING OF WASTE WATERS IN CLOSED RESERVOIRS (IN RUSSIAN), W70-01078	05B
MOORE, DESMOND F. ON THE CONCEPT OF MEAN HYDRAULIC RADIUS, W70-01117	08B	PALMER, C. M. A COMPOSITE RATING OF ALGAE TOLERATING ORGANIC POLLUTION, W70-01233	05C
MORRIS, ARTHUR S. THE DEVELOPMENT OF THE IRRIGATION ECONOMY OF MENDOZA, ARGENTINA, W70-01213	03F	PANENKOV, A. S. RELATION BETWEEN THE STATIC AND THE DYNAMIC DEFORMATION INDEXES OF ROCK IN LARGE-SCALE TESTS ON ROCK MASSSES, W70-01124	08E
MULLER, GERMAN DIAGENETIC CHANGES IN INTERSTITIAL WATERS OF HOLOCENE LAKE CONSTANCE SEDIMENTS, W70-01009	02H	PARDOE, G. K. C. EARTH RESOURCE SATELLITES, W70-01098	07B
MURDOCK, JOHN H., JR. NOTES ON WATER WORKS LAW SECOND INSTALLMENT - IRRIGATION AND RIPARIAN RIGHTS, W70-00920	06B	PECK, R. B. ADVANTAGES AND LIMITATIONS OF THE OBSERVATIONAL METHOD IN APPLIED SOIL MECHANICS, W70-01092	08D
MURPHY, R. SAGE A GROUNDWATER QUALITY SUMMARY FOR ALASKA, W70-01087	04B	PECSE, M. THE DYNAMICS OF QUATERNARY SLOPE EVOLUTION AND ITS GEOMORPHOLOGICAL REPRESENTATION, W70-01041	02J
A WATER DISTRIBUTION SYSTEM FOR COLD REGIONS, THE SINGLE MAIN RECIRCULATING METHOD. AN HISTORICAL REVIEW, FIELD EVALUATION, AND SUGGESTED DESIGN PROCEDURES, W70-01088	04A	PENCE, G. D. MATHEMATICAL SIMULATION OF THE ESTUARINE BEHAVIOR AND ITS APPLICATIONS, W70-00896	05C
MURROW, RICHARD NEW WATER BIRD FOR EGYPT A ROBOT SHADOF, W70-01205	03F	PERLA, RONALD I. STRENGTH TEST ON NEWLY FALLEN SNOW, W70-01221	07B
MUTCHLER, CALVIN K. SOIL MOVEMENT ON IRREGULAR SLOPES, W70-00864	02J	PETERSON, FRANK L. A HYDROGEOPHYSICAL SURVEY FROM KAWAIAHE TO KAILUA-KONA, HAWAII, W70-00908	03B
NAITO, M. OPTIMIZATION OF THE ACTIVATED SLUDGE PROCESS-OPTIMUM VOLUME RATIO OF AERATION AND SEDIMENTATION VESSELS, W70-00893	05D	PETERSON, JAMES T. THE CLIMATE OF CITIES A SURVEY OF RECENT LITERATURE, W70-00988	10
NANACKOVA-ZEKECVA, ZDENA THE USE OF THE FUNDAMENTAL STUDIES OF BIOLOGICAL PURIFICATION ON THE PURIFICATION OF POLLUTED WATERS DERIVED FROM PRODUCTION OF 'KHEMLOV' (SLOVAKIAN), W70-00879	05D	PHILIP, J. E. HYDROSTATICS AND HYDRODYNAMICS IN SWELLING SOILS, W70-00841	02G
MARKIS, N. EFFECT OF POLYELECTROLYTES IN CONJUNCTION WITH BENTONITIC CLAY ON CONTAMINANTS REMOVAL FROM SECONDARY EFFLUENTS, W70-00845	05D	POLIKARPOV, G. STRONTIUM-90 CONCENTRATION FACTORS OF LAKE PLANKTON, MACROPHYTES, AND SUBSTRATES, W70-01010	05C
NELSON, ALAN R. ANALYTICAL STUDIES OF TURBULENT FRICTION IN ANNULAR CONDUTS, W70-01045	08B	POTTER, PAUL EDWIN DISTINGUISHING MARINE AND FRESHWATER MUDS, W70-00994	02K
NELSON, D. J. ESTIMATES OF PERiphyton MASS AND STREAM BOTTOM AREA USING PHOSPHOROUS-32, W70-00846	02I	PRAVOSHINSKY, N. A. CALCULATION OF WATER POLLUTION BY SURFACE RUNOFF, W70-01026	05B
NELSON, K. H. APPLICATION OF PYROLYTIC GAS CHROMATOGRAPHY TO NATURAL WATERS, W70-00847	05A	PRIHA, SEppo HYDRAULIC PROPERTIES OF SMALL UNLINED ROCK TUNNELS, W70-01115	08B
NICHIPOROVICH, A. A. DETERMINING PORE PRESSURE IN SLIGHTLY PERMEABLE SOILS IN THE BODY OF A DAM DURING THE PROCESS OF THEIR CONSOLIDATION, W70-01091	08D	PROBSTINE, RONALD EXPERIMENTAL STUDY OF SLURRY SEPARATORS FOR USE IN DEASALINATION, W70-00892	03A
NIELSEN, D. R. STADY FLOW OF WATER THROUGH A TWO-LAYER SOIL, W70-00840	02G	PUENTES, C. D. STORAGE YIELD EXTENDING THE SEQUENT PEAK ALGORITHM TO MULTIPLE RESERVOIRS, W70-01000	06A
NOVOTNY, V. ON THE DIFFUSION PHENOMENA IN BOUNDARY LAYERS OF TURBULENT FLOW AND ITS INFLUENCE ON THE COURSE OF THE SELF- PURIFICATION OF SMALL STREAMS, W70-01037	05C	PYLAEV, N. I. INCREASING THE CAVITATION RESISTANCE OF PARTS BY USING EXPLOSIVE-WELDED FACINGS, W70-01127	08C
OERTLI, J. J. EFFECTS OF EXTERNAL SALT CONCENTRATIONS ON WATER RELATIONS IN PLANTS SIGNIFICANCE OF EXTERNAL WATER-POTENTIAL AND SALT-TRANSPORT KINETICS ON RATE OF CELL EXPANSION, W70-01214	02I	RABE, FRED W. A LIMNOLOGICAL COMPARISON OF TWO SMALL IDAHO RESERVOIRS, W70-01005	02H
OIFF, W. D. A RAPID FOR MEASURING THE ACUTE TOXICITY OF DISSOLVED MATERIALS TO MARINE FISHES, W70-00849	05A	RAHN, PERRY R. SHEETFLOODS, STREAMFLOODS, AND THE FORMATION OF PEDIMENTS, W70-01211	02J
ONSTAD, C. A. SUBSURFACE FLOW REGIMES OF A HYDROLOGIC WATERSHED MODEL, W70-01237	02F	RAPHAEL, DAVID L. WATER QUALITY AND REGIONAL ECONOMY, A DECISION MODEL, W70-00897	05G
OPP, L. D. THE DIURETIC RESPONSE BY RAINBOW TROUT TO SUB-LETHAL CONCENTRATIONS OF AMMONIA, W70-00848	05C	RAPP, ANDERS PLEISTOCENE ACTIVITY AND HOLOCENE STABILITY OF HILLSLOPES, WITH EXAMPLES FROM SCANDINAVIA AND PENNSYLVANIA, W70-01042	02J
OWENS, M.		READ, J. B. L. VILLAGE WATER SUPPLY INVESTIGATION, TERRITORY OF PAPUA AND NEW GUINEA, W70-00991	03B
		REBHUN, M. EFFECT OF POLYELECTROLYTES IN CONJUNCTION WITH BENTONITIC CLAY ON CONTAMINANTS REMOVAL FROM SECONDARY EFFLUENTS,	

		AUTHOR INDEX	REB-SWI
W70-00845	05D	W70-00892	03A
PEED, S. C. WASTEWATER DISPOSAL AND MICROBIAL ACTIVITY AT ICE-CAP FACILITIES, W70-00882	05C	SIEBURTH, JOHN MCN STUDIES ON ALGAL SUBSTANCES IN THE SEA. II. THE FORMATION OF GELBSTOFF (HUMIC MATERIAL) BY EXUDATES OF PHAEOPHYTA, W70-01072	05B
RESCH, F. A STUDY OF HOT WIRE AND HOT FILM ANEMOMETERS IN WATER (FRENCH), W70-00868	07B	STUDIES ON ALGAL SUBSTANCES IN THE SEA. III. THE PRODUCTION OF EXTRACELLULAR ORGANIC MATTER BY LITTORAL MARINE ALGAE, W70-01073	05B
RIB, HAROLD T. MULTISENSOR ANALYSIS FOR SOILS MAPPING, W70-01125	07B	STUDIES ON ALGAL SUBSTANCES IN THE SEA. I. GELBSTOFF (HUMIC MATERIAL) IN TERRESTRIAL AND MARINE WATERS, W70-01074	05B
BICE, PAYMOND H. SOIL SLIPPAGE AN INDICATOR OF SLOPE INSTABILITY ON CHAFFARRAL WATERSHEDS OF SOUTHERN CALIFORNIA, W70-01196	02J	SIEBURTH, JOHN MCNEILL THE INFLUENCE OF ALGAL ANTIBIOSIS ON THE ECOLOGY OF MARINE MICROORGANISMS, W70-01065	05C
BICE, ROBERT C. REVIEW OF METHODS FOR MEASURING AND PREDICTING SEEPAGE, W70-01238	04A	SILVEY, J. K. G. NITRGEN FIXATION BY GLOEOPCAPSA, W70-01070	05C
RIKKERS, ROBERT F. A SYSTEMS APPROACH TO WASTE MANAGEMENT, W70-00898	05D	SIMANTON, J. R. NET RADIATION IN A RIPARIAN MESQUITE COMMUNITY, W70-00853	02I
ROBERTSON, JAMES H. ANALYTICAL STUDIES OF TURBULENT FRICTION IN ANNULAR CONDUITS, W70-01045	08B	SITTNER, WALTER T. CONTINUOUS HYDROGRAPH SYNTHESIS WITH AN API-TYPE HYDROLOGIC MODEL, W70-00860	02A
TURBULENT FRICTION IN ECCENTRIC ANNULAR CONDUITS, W70-01046	08B	SJOGREN, B. ON A SOIL AND GROUND WATER INVESTIGATION WITH THE SHALLOW REFRACTION METHOD AT HO I BANA, W70-00995	07B
RODZILLER, L. D. DILUTION OF WASTE EFFLUENTS IN WATERS (IN RUSSIAN), W70-01084	05G	SLAGLE, K. A. OIL FIELDS YIELD NEW DEEP-WELL DISPOSAL TECHNIQUE, W70-00990	05E
ROSENBERG, NORMAN J. COMPUTER PROGRAM FOR PLOTTING TIME DEPENDENT DATA WITH INSTRUCTION AND EXAMPLES, W70-01008	07C	SMITH, K. SOME THERMAL CHARACTERISTICS OF TWO RIVERS IN THE PENNINE AREA OF NORTHERN ENGLAND, W70-00881	05B
ROTHACHFER, JACK INCREMENTS IN MAXIMUM STREAM TEMPERATURES AFTER SLASH BURNING IN A SMALL EXPERIMENTAL WATERSHED, W70-01220	07C	SNEAD, RODMAN E. WEATHER PATTERNS IN SOUTHERN WEST PAKISTAN, W70-01197	02B
RUCHTI, J. STATISTICAL CHARACTERIZATION OF MIXTURES OF HYDROCARBONS, W70-01025	05A	SNYDER, WILLARD M. A WATER YIELD MODEL DERIVED FROM MONTHLY RUNOFF DATA, W70-00905	03B
SAVIGEAR, R. A. G. THE ANALYSIS AND CLASSIFICATION OF SLOPE PROFILE FORMS, W70-01040	02J	SPRAGUE, JOHN B. AVOIDANCE REACTIONS OF SALMONID FISH TO REPRESENTATIVE POLLUTANTS, W70-01032	05C
SCALF, MARION E. MOVEMENT OF DDT AND NITRATES DURING GROUND-WATER RECHARGE, W70-00861	05B	SRINILTA, SAM-ABNO STEADY FLOW OF WATER THROUGH A TWO-LAYER SOIL, W70-00840	02G
SCHAUSS, CHARLES E. CONTINUOUS HYDROGRAPH SYNTHESIS WITH AN API-TYPE HYDROLOGIC MODEL, W70-00860	02A	STAMP, BRIAN A. THE CONSTITUTIONAL ASPECTS OF WATER POLLUTION AND THE NEED FOR GOVERNMENTAL COOPERATION, W70-00915	05G
SCHLAG, A. EXPERIMENTAL RESEARCH ON SPILLWAY SHAFT FLOW (FRENCH), W70-00873	08B	STEGMAN, E. C. A PHYSICAL AND ECONOMIC ANALYSIS OF ALTERNATIVE IRRIGATION METHODS IN A SUB-HUMID CLIMATE, W70-01086	03F
SCHELEICHFER, J. A. DISTINGUISHING MARINE AND FRESHWATER MUDS, W70-00994	02K	STEPHENSON, G. R. DIGITIZED PHYSICAL DATA OF A RANGELAND WATERSHED, W70-00993	07C
SCHUMACHER, B. W. ELECTRON BEAMS APPLY AN OLD PRINCIPLE TO MODERN ROCK- BREAKING, W70-01109	08H	STINSON, P. J. OPTIMIZATION TECHNIQUES IN WEATHER MODIFICATION, W70-01122	03B
SCHWEIG, ZEV AQUEDUCT ROUTE OPTIMIZATION BY DYNAMIC PROGRAMMING, W70-00894	04A	STOGNER, J. M. OIL FIELDS YIELD NEW DEEP-WELL DISPOSAL TECHNIQUE, W70-00990	05E
SEABORG, GLENN T. THE ENVIRONMENT--AND WHAT TO DO ABOUT IT, W70-01106	04D	STOUT, G. E. SOME OBSERVATIONS OF CLOUD INITIATION IN INDUSTRIAL AREAS, W70-01240	05C
SEBESTYEN, G. DETECTION OF CAVITATION BY ACOUSTIC AND VIBRATION- MEASUREMENT METHODS, W70-00875	08B	STRASKAROVA, V. BACTERIAL AND PROTOZOAN INDICATORS OF WATER POLLUTION - STATISTICAL AND EXPERIMENTAL APPROACH, W70-01036	05A
SETSER, J. L. SAMPLING AND ANALYSIS OF WASTE WATER FROM INDIVIDUAL HOMES (TASK 2), W70-01050	08B	SUESS, PEWIN CALCIUM CARBONATE INTERACTION WITH ORGANIC COMPOUNDS, W70-01069	02K
SHAIIRO, JOSEPH STUDIES ON NATURAL FACTORS AFFECTING PHOSPHATE ABSORPTION AND ITS UTILIZATION BY ALGAE, W70-01031	05C	SUGIKI, AKINORI COMPREHENSIVE WATER RESOURCES STUDIES ON THE ARA VALLEY AREA, JAPAN, W70-01034	05G
SHIMP, N. F. DISTINGUISHING MARINE AND FRESHWATER BUDS, W70-00994	02K	SUZUKI, KATSURO FIELD TEST RESULTS ON 113,000 KW FRANCIS PUMP-TURBINES FOR NAGANO POWER STATION, W70-01097	08C
SHWARTZ, JOSEPH EXPERIMENTAL STUDY OF SLURRY SEPARATORS FOR USE IN DESALINATION,		SWINZOW, G. K.	

CERTAIN ASPECTS OF ENGINEERING GEOLOGY IN PERMAFROST, W70-01011	08D	CLAY ON CONTAMINANTS REMOVAL FROM SECONDARY EFFLUENTS, W70-00845	05D
SYUZYUMOV, L. M. ON THE POSSIBILITY OF ESTIMATING THE THICKNESS OF UNCONSOLIDATED ROCKS BY VERTICAL ELECTRICAL SOUNDING IN PERMAFROST AREAS (RUSSIAN). W70-00878	07B	WAGER, O. ON A SOIL AND GROUND WATER INVESTIGATION WITH THE SHALLOW REFRACTION METHOD AT MO I RANA, W70-00995	07B
TAKAMATSU, T. OPTIMIZATION OF THE ACTIVATED SLUDGE PROCESS--OPTIMUM VOLUME RATIO OF AERATION AND SEDIMENTATION VESSELS, W70-00893	05D	WAGNER, C. L. ELECTRICAL DESIGN OF PARAMETERS USED FOR EHV SYSTEMS, W70-01093	08C
TECLAFF, LUDWIK A. PRIVATE WATER RIGHTS IN FRANCE AND IN THE EASTERN UNITED STATES, W70-00916	06B	WAGNER, H. C. GEOLOGY, PETROLEUM DEVELOPMENT, AND SEISMICITY OF THE SANTA BARBARA CHANNEL REGION, CALIFORNIA, W70-00836	05B
W70-00917	06B	WAGNER, SEYMOUR C. STATUTORY STREAM POLLUTION CONTROL, W70-00923	05G
W70-00918	06B	W70-00924	05G
W70-00919	06B	W70-00925	05G
TIBAR, H. A. ABOUT THE QUESTION OF VERTICAL MIXING OF WASTE WATERS IN CLOSED RESERVOIRS (IN RUSSIAN). W70-01078	05B	W70-00926	05G
TOBIASSON, W. WASTEWATER DISPOSAL AND MICROBIAL ACTIVITY AT ICE-CAP FACILITIES, W70-00882	05C	WAITE, G. GRAHAM THE DILEMMA OF WATER RECREATION AND A SUGGESTED SOLUTION, W70-00930	06D
TRAPEZNİKOV, L. P. CRACKS IN BLOCKS OF THE BRATSK HYDROELECTRIC STATION DAM. W70-01119	08F	THE DILEMMA OF WATER RECREATION AND A SUGGESTED SOLUTION (PART I), W70-00931	06D
TROMBLE, J. M. NET RADIATION IN A BIPARIAN MESQUITE COMMUNITY, W70-00853	02I	THE DILEMMA OF WATER RECREATION AND A SUGGESTED SOLUTION (PART II), W70-00932	06D
TSEMAKHOVICH, B. D. INCREASING THE CAVITATION RESISTANCE OF PARTS BY USING EXPLOSIVE-WELDED FACINGS, W70-01127	08C	WALLER, DONALD H. EXPERIENCE WITH GRINDING AND PUMPING OF SEWAGE FROM BUILDINGS, W70-01056	08C
TSYBUL'NIK, T. I. DETERMINING POSE PRESSURE IN SLIGHTLY PERMEABLE SOILS IN THE BODY OF A DAM DURING THE PROCESS OF THEIR CONSOLIDATION, W70-01091	08D	PEAK FLOWS OF SEWAGE FROM INDIVIDUAL HOUSES, W70-01062	08E
TUCKER, L. SCOTT SEWAGE FLOW VARIATIONS IN INDIVIDUAL HOMES, W70-01055	08B	AN EXAMINATION OF THE BENEFITS AND DISADVANTAGES WITH RESPECT TO THE DISPOSAL OF SOLID WASTES, W70-01063	05D
PRESSURE TUBING FIELD INVESTIGATION, W70-01058	08A	NON-MECHANICAL CONSIDERATIONS INVOLVED IN IMPLEMENTING PRESSURIZED SEWERAGE SYSTEMS, W70-01065	08A
HYDRAULICS OF A PRESSURIZED SEWERAGE SYSTEM AND USE OF CENTRIFUGAL PUMPS, W70-01059	08C	SPECIAL REQUIREMENTS FOR A FULL SCALE FIELD DEMONSTRATION OF THE ASCE COMBINED SEWER SEPARATION PROJECT SCHEME, W70-01066	08A
MINIMUM TRANSPORT VELOCITY FOR PRESSURIZED SANITARY SEWERS, W70-01060	08B	WALTHER, EWELL P., JR. ACQUISITION OF THE RIGHT TO USE WATER, W70-01137	06E
ROUTING OF FLOWS IN SANITARY SEWERAGE SYSTEMS, W70-01067	08A	WARD, BRUCE D. RELATIVE DENSITY EFFECTS ON INCIPENT BED MOVEMENT, W70-00865	02J
UKHOV, S. B. RELATION BETWEEN THE STATIC AND THE DYNAMIC DEFORMATION INDEXES OF ROCK IN LARGE-SCALE TESTS ON ROCK MASSES, W70-01124	08E	WARD, J. K. G. FREQUENCY ANALYSES OF FLOODS AND DROUGHTS, W70-01120	02E
VAN DER KAMP, G. S. DETERMINING AQUIFER CHARACTERISTICS BY THE TIDAL METHOD, W70-00859	02F	WARREN, CLIFTON A HYDROGEOPHYSICAL SURVEY FROM KAWAIHAE TO KAILUA-KONA, HAWAII, W70-00908	03B
VAN DER KROON, G. T. M. THE INFLUENCE OF SUSPENDED SOLIDS ON THE RATE OF OXYGEN TRANSFER IN AQUEOUS SOLUTIONS, W70-01023	05D	WASSERMAN, LARRY PAUL SWEETWATER POLLUTION, W70-01104	05B
VAN 'T SOUTD, B. D. TRICKLE IRRIGATION -- A PROMISING SECOND TOOL FOR A BREAKTHROUGH IN FOOD PRODUCTION IN TROPICAL, SUBTROPICAL AND DESERT AREAS, W70-01218	03F	WATSON, RICHARD L. MODIFIED RUBEY'S LAW ACCURATELY PREDICTS SEDIMENT SETTLING VELOCITIES, W70-00855	02J
VARGA, J. J. DETECTION OF CAVITATION BY ACOUSTIC AND VIBRATION- MEASUREMENT METHODS, W70-00875	08B	WELDER, FRANK A. RECORDS OF SELECTED WELLS AND SPRINGS IN THE RULISON PROJECT AREA, GARFIELD AND MESA COUNTIES, COLORADO, W70-00987	07C
VAUGHN, GRANT W. SEASONAL VARIATION IN RAIN GAGE CATCH, W70-00854	02B	WHITE, GILBERT F. THE CHANGING ROLE OF WATER IN ARID LANDS, W70-01199	06B
VEDDER, J. G. GEOLOGY, PETROLEUM DEVELOPMENT, AND SEISMICITY OF THE SANTA BARBARA CHANNEL REGION, CALIFORNIA, W70-00836	05B	WHITTINGTON, B. B. CONVERGENT STILLING BASINS, W70-01099	08B
VON TUMPLING, WOLF THE CLASSIFICATION OF WATER QUALITY FROM THE BIOLOGICAL POINT OF VIEW, W70-01029	05A	WIDMAR, JOSEPH H. CONSTITUTIONAL LAW--COMMERCE CLAUSE--WATER RIGHTS IN THE FLOW OF A NON-NAVIGABLE STREAM ARE PROPERTY RIGHTS, W70-00922	04A
WACHS, A. M. EFFECT OF POLYELECTROLYTES IN CONJUNCTION WITH BENTONITIC		WIENS, HEROLD J. REGIONAL AND SEASONAL WATER SUPPLY IN THE TARIM BASIN AND ITS RELATION TO CULTIVATED LAND POTENTIALS, W70-01210	03F
40		WILDERER, PETFR PHYSICAL AND BIOCHEMICAL ASPECTS OF BOD KINETICS, W70-01024	05C

AUTHOR	INDEX	
WILHELM, J. L. ESTIMATES OF PERIPHYTON MASS AND STREAM BOTTOM AREA USING PHOSPHOROUS-32, W70-00846	02I	W70-01070 05C
WILKINS, J. K. DECKED ROCKFILL DAMS, W70-01121	08D	YAKUPOV, V. S. ON THE POSSIBILITY OF ESTIMATING THE THICKNESS OF UNCONSOLIDATED ROCKS BY VERTICAL ELECTRICAL SOUNDING IN PERmafrost AREAS (RUSSIAN), W70-00878 07B
WILLIAMS, G. P. WATER TEMPERATURE DURING THE MELTING OF LAKE ICE, W70-00852	02H	YAMAMOTO, KAKEHIKO FIELD TEST RESULTS ON 113,000 KW FRANCIS PUMP-TURBINES FOR NAGANO POWER STATION, W70-01097 08C
WILLIAMS, I. V. IMPLICATION OF WATER QUALITY AND SALINITY IN THE SURVIVAL OF FRASER RIVER SOCKEYE SMOLTS, W70-01225	05C	YEN, BEN CHIE A LABORATORY STUDY OF SURFACE RUNOFF DUE TO MOVING RAINSTORMS, W70-00839 02A
WILLIAMS, ROY E. TEMPORAL, HORIZONTAL AND VERTICAL VARIABILITY OF WATER CHEMISTRY IN UNSATURATED ZONE OF FINE-GRAINED SOILS, W70-00911	05B	YERKES, R. F. GEOLOGY, PETROLEUM DEVELOPMENT, AND SEISMICITY OF THE SANTA BARBARA CHANNEL REGION, CALIFORNIA, W70-00836 05B
WILSON, WOODROW W. RECORDS OF SELECTED WELLS AND SPRINGS IN THE RULISON PROJECT AREA, GARFIELD AND MESA COUNTIES, COLORADO, W70-00987	07C	YOUNG, G. K. STORAGE YIELD EXTENDING THE SEQUENT PEAK ALGORITHM TO MULTIPLE RESERVOIRS, W70-01000 06A
WITTERS, J. DISTINGUISHING MARINE AND FRESHWATER MUDS, W70-00994	02K	YOUNG, ROBERT A. SOIL MOVEMENT ON IRREGULAR SLOPES, W70-00864 02J
WORSTELL, R. V. FIELD EVALUATION OF SEEPAGE MEASUREMENT METHODS, W70-01236	04A	THE ECONOMICS OF ARIZONA'S WATER PROBLEM, W70-01200 06D
WRIGHT, D. E. PHOTOGRAMMETRIC MEASUREMENT OF ROCK SURFACES IN A POWER TUNNEL, W70-01090	07B	ZAGUSTIN, A. ANALYTICAL SOLUTION FOR TURBULENT FLOW IN PIPES, W70-00870 08B
WROBEL, STANISLAW CAUSES AND CONSEQUENCES OF POND EUTROPHICATION (POLISH), W70-01082	05F	ZAGUSTIN, K. ANALYTICAL SOLUTION FOR TURBULENT FLOW IN PIPES, W70-00870 08B
WU, JYN AN ESTIMATION OF WIND EFFECTS ON DISPERSION IN WIDE CHANNELS, W70-00842	02E	ZAKJAROVENKO, G. M. ON THE HYDROGEOLOGY OF THE CENTRAL AND NORTHWESTERN PART OF THE DNIPEPER-DONETS ARTESIAN BASIN (UKRAINIAN), W70-00866 02K
WYATT, J. T. NITROGEN FIXATION BY GLOEOCAPSAS,		ZNAMENSKYI, V. A. PHYSICAL MODELING OF REGIME OF BODIES OF WATER TO STUDY THEIR SANITATION CONDITION (IN RUSSIAN), W70-00885 05B



ORGANIZATIONAL INDEX

AGRICULTURAL RESEARCH SERVICE, BOISE, IDAHO. NORTHWEST WATERSHED RESEARCH CENTER AND AGRICULTURAL RESEARCH SERVICE, BELTSVILLE, MD. HYDROGRAPH LAB. DIGITIZED PHYSICAL DATA OF A RANGELAND WATERSHED, W70-00993	07C	FOR PRESSURE SEWERS, W70-01047	08B
AGRICULTURAL RESEARCH SERVICE, COCHCOTON, OHIO. SOIL AND WATER CONSERVATION RESEARCH DIV. AND WEATHER BUREAU, AKRON, OHIO. EASTERN REGION. SEASONAL VARIATION IN RAIN GAGE CATCH, W70-00854	02B	ADVANCED DEVELOPMENT OF HOUSEHOLD PUMP-STORAGE-GRINDER UNIT (TASK 6), W70-01048	08C
AGRICULTURAL RESEARCH SERVICE, COSHOCTON, OHIO. CORN BELT BRANCH. EFFECTS OF CULTIVATION AND GRASS ON SURFACE RUNOFF, W70-00863	04A	LONG-TERM OPERATION OF WASTEWATER OBSERVATION STATIONS (TASK 2), W70-01049	08B
AGRICULTURAL RESEARCH SERVICE, FRESNO, CALIF. SOIL AND WATER CONSERVATION RESEARCH DIV. AND NEVADA UNIV., RENO. DESERT RESEARCH INST. AN EMPIRICAL METHOD FOR ESTIMATING MONTHLY POTENTIAL EVAPOTRANSPIRATION IN NEVADA, W70-01004	02D	SAMPLING AND ANALYSIS OF WASTE WATER FROM INDIVIDUAL HOMES (TASK 2), W70-01050	08B
AGRICULTURAL RESEARCH SERVICE, MORRIS, MINN. SOIL AND WATER CONSERVATION RESEARCH DIV. SOIL MOVEMENT ON IRREGULAR SLOPES, W70-00864	02J	OUTLINE DESCRIPTION OF ASCE PROJECT ON "SEPARATION OF SANITARY SEWAGE FROM COMBINED SYSTEMS OF SEWERAGE", W70-01054	08A
AGRICULTURAL RESEARCH SERVICE, PHOENIX, ARIZ. WATER CONSERVATION LAB. REVIEW OF METHODS FOR MEASURING AND PREDICTING SEEPAGE, W70-01238	04A	SEWAGE FLOW VARIATIONS IN INDIVIDUAL HOMES, W70-01055	08B
AGRICULTURAL RESEARCH SERVICE, TUCSON, ARIZ. SOUTHWEST WATERSHED RESEARCH CENTER. NET RADIATION IN A RIPARIAN MESQUITE COMMUNITY, W70-00853	02I	EXPERIENCE WITH GRINDING AND PUMPING OF SEWAGE FROM BUILDINGS, W70-01056	08C
AN INEXPENSIVE SHALLOW WATER TABLE PROBE, W70-00996	07B	STUDY OF APPROXIMATE LENGTHS AND SIZES OF COMBINED SEWERS IN MAJOR METROPOLITAN CENTERS, W70-01057	08A
AIR FORCE INST. OF TECH., WRIGHT-PATTERSON, AFB, OHIO AND OKLAHOMA STATE UNIV., STILLWATER. SURFACE AND SUBSURFACE EXPLORATION BY INFRARED SURVEYS, W70-01128	07B	PRESSURE TUBING FIELD INVESTIGATION, W70-01058	08A
AKADEMIYA NAUK SSSR, MOSCOW. INSTITUT GEOGRAFI. THE STUDY OF LOCAL WATERS IN THE DESERTS OF THE USSR, W70-01216	03B	HYDRAULICS OF A PRESSURIZED SEWERAGE SYSTEM AND USE OF CENTRIFUGAL PUMPS, W70-01059	08C
AKADEMIYA NAUK SSSR. INSTITUT OKEANOLOGII. NONLINEAR THEORY OF WIND DRIFT OF ICE (RUSSIAN), W70-01018	02C	MINIMUM TRANSPORT VELOCITY FOR PRESSURIZED SANITARY SEWERS, W70-01060	08B
AKADEMIYA NAUK URSR. INST. OF BIOLOGY OF THE SOUTHERN SEAS. SSTRONTIUM-90 CONCENTRATION FACTORS OF LAKE PLANKTON, MACROPHYTES, AND SUBSTRATES, W70-01010	05C	DOMESTIC SEWAGE FLOW CRITERIA FOR EVALUATION OF PROJECT SCHEME TO ACTUAL COMBINED SEWER DRAINAGE AREAS, W70-01061	08B
ALASKA UNIV., COLLEGE. INST. OF WATER RESOURCES. A GROUNDWATER QUALITY SUMMARY FOR ALASKA, W70-01087	04B	PEAK FLOWS OF SEWAGE FROM INDIVIDUAL HOUSES, W70-01062	08B
A WATER DISTRIBUTION SYSTEM FOR COLD REGIONS, THE SINGLE MAIN RECIRCULATING METHOD. AN HISTORICAL REVIEW, FIELD EVALUATION, AND SUGGESTED DESIGN PROCEDURES, W70-01088	04A	AN EXAMINATION OF THE BENEFITS AND DISADVANTAGES WITH RESPECT TO THE DISPOSAL OF SOLID WASTES, W70-01063	05D
ALL-UNION RESEARCH INSTITUTE FOR WATER ENGINEERING AND RECLAMATION, MOSCOW. THE WATER PROBLEM IN THE DESERTS OF THE USSR, W70-01215	03B	CONTROL TECHNIQUES FOR PRESSURIZED SEWERAGE SYSTEMS, W70-01064	08C
AMERICAN SOCIETY OF CIVIL ENGINEERS, NEW YORK AND CAMP, DRESSER AND MCKEE, BOSTON, MASS. REPORT ON PRESSURE SEWERAGE SYSTEM, SUMMER STREET SEPARATION STUDY AREA, BOSTON, MASSACHUSETTS, W70-01051	08A	NON-MECHANICAL CONSIDERATIONS INVOLVED IN IMPLEMENTING PRESSURIZED SEWERAGE SYSTEMS, W70-01065	08A
AMERICAN SOCIETY OF CIVIL ENGINEERS, NEW YORK GREELEY AND HANSEN, CHICAGO, ILL. COMBINED SEWER SEPARATION PROJECT, REPORT ON MILWAUKEE STUDY AREA, W70-01052	08A	SPECIAL REQUIREMENTS FOR A FULL SCALE FIELD DEMONSTRATION OF THE ASCE COMBINED SEWER SEPARATION PROJECT SCHEME, W70-01066	08A
AMERICAN SOCIETY OF CIVIL ENGINEERS, NEW YORK. FINAL REPORT TO THE AMERICAN SOCIETY OF CIVIL ENGINEERS ON TASK 7 AND TASK 9 OF THE COMBINED SEWER SEPARATION PROJECT, W70-01043	08A	ROUTING OF FLOWS IN SANITARY SEWERAGE SYSTEMS, W70-01067	08A
DEVELOP AND FIELD TEST METHOD OF INSTALLING PRESSURE CONDUITS IN COMBINED SEWERS, W70-01044	08A	ARIZONA UNIV., TUCSON AND ARIZONA COOPERATIVE FISHERY UNIT, TUCSON. LIMNOLOGICAL EFFECTS OF ORGANIC EXTRACTS OF LITTER IN A SOUTHWESTERN IMPOUNDMENT, W70-01080	02H
ANALYTICAL STUDIES OF TURBULENT FRICTION IN ANNULAR CONDUITS, W70-01045	08B	ARIZONA UNIV., TUCSON. DEPT. OF AGRICULTURAL ECONOMICS. PATTERNS OF WATER USE IN THE ARIZONA ECONOMY, W70-01202	06D
TURBULENT FRICTION IN ECCENTRIC ANNULAR CONDUITS, W70-01046	08B	ARIZONA UNIV., TUCSON. DEPT. OF AGRICULTURAL ECONOMICS. THE ECONOMICS OF ARIZONA'S WATER PROBLEM, W70-01200	06D
RELATIONSHIP OF SEWAGE CHARACTERISTICS TO CARRYING VELOCITY		ARMY TERRESTRIAL SCIENCES CENTER, HANOVER, N.H. WASTEWATER DISPOSAL AND MICROBIAL ACTIVITY AT ICE-CAP FACILITIES, W70-00882	05C
		CERTAIN ASPECTS OF ENGINEERING GEOLOGY IN PERMAFROST, W7C-01011	08D
		ATOMIC ENERGY COMMISSION, WASHINGTON, D.C. THE ENVIRONMENT--AND WHAT TO DO ABOUT IT, W70-01106	04D
		BATTELLE MEMORIAL INST., RICHLAND, WASH. PACIFIC NORTHWEST	

ORGANIZATIONAL INDEX

LABS. NUCLEAR POWER PLANT SITING IN THE PACIFIC NORTHWEST FOR THE BONNEVILLE POWER ADMINISTRATION, W70-00883	05D	CONNECTICUT UNIV., STOLES. SHEETFLOODS, STREAMFLOODS, AND THE FORMATION OF PEDIMENTS, W70-01211 02J
BELGRADE UNIV. (YUGOSLAVIA). OPTIMIZATION OF THE LONG-TERM OPERATION OF A SINGLE-PURPOSE RESERVOIR, W70-00901	03B	CORNELL UNIV., ITHACA, N.Y. DEPT. OF WATER RESOURCES ENGINEERING. STOCHASTIC METHODS FOR ANALYZING RIVER BASIN SYSTEMS, W70-01085 06A
BIHAR UNIV., MUZAFFARPUR (INDIA). DEPT. OF ZOOLOGY. FISHERY MANAGEMENT WITH THE HELP OF THE ORGANOPHOSPHORUS INSECTICIDE, THIOMETON, W70-01232	05C	CORPS OF ENGINEERS, SACRAMENTO, CALIF. FLOOD PLAIN INFORMATION, TROUT AND BIJOU CREEKS, SOUTH LAKE TAHOE, CALIFORNIA. W70-00856 04A
BIRMINGHAM UNIV. (ENGLAND). DEPT. OF CIVIL ENGINEERING. TIME VARIANT GROUND WATER FLOW BY RESISTANCE NETWORK ANALOGUES, W70-01039	02F	DARTMOUTH COLL., HANOVER, N.H. AND YALE UNIV., NEW HAVEN, CONN. USE OF MEMBRANE FILTERS IN GRAVIMETRIC ANALYSES OF PARTICULATE MATTER IN NATURAL WATERS, W70-00857 07B
BROWN AND CALDWELL, SAN FRANCISCO, CALIF. SEPARATION OF COMBINED WASTEWATER AND STORM DRAINAGE SYSTEMS, SAN FRANCISCO STUDY AREA. W70-01053	08A	DENVER, COLO. OPTIMIZATION TECHNIQUES IN WEATHER MODIFICATION, W70-01122 03B
BUREAU OF MINERAL RESOURCES, GEOLOGY AND GEOPHYSICS, CANBERRA (AUSTRALIA). VILLAGE WATER SUPPLY INVESTIGATION, TERRITORY OF PAPUA AND NEW GUINEA, W70-00991	03B	DEPARTMENT OF AGRICULTURE, BELTSVILLE, MD. SUBSURFACE FLOW REGIMES OF A HYDROLOGIC WATERSHED MODEL, W70-01237 02F
BUREAU OF PUBLIC ROADS, WASHINGTON, D.C. AND PURDUE UNIV., LAFFAYETTE, IND. MULTISENSOR ANALYSIS FOR SOILS MAPPING, W70-01125	07B	DEPARTMENT OF CONSERVATION AND ECONOMIC DEVELOPMENT, RICHMOND, VA. DIV. OF MINERAL RESOURCES. NATURAL FEATURES CAUSED BY A CATASTROPHIC STORM IN NELSON AND AMHERST COUNTIES, VIRGINIA. W70-00992 02E
BUREAU OF RECLAMATION, DENVER, COLO. UPLIFT RESISTANCE OF ANCHOR BAR, AUGER AND PRESSED PLATE FOOTINGS IN SANDY SILT, W70-01096	08C	DEPARTMENT OF ENERGY, MINES AND RESOURCES, OTTAWA (ONTARIO). INLAND WATERS BRANCH. DETERMINING AQUIFER CHARACTERISTICS BY THE TIDAL METHOD, W70-00859 02F
CONTROLLING THE EXPANSION OF DESICCATED CLAYS DURING CONSTRUCTION. W70-01112	08D	DEPARTMENT OF ENERGY, MINES AND RESOURCES, OTTAWA (ONTARIO). INLAND WATERS BRANCH AND MCGILL UNIV., MONTREAL (QUEBEC). A STOCHASTIC APPROACH TO THE DEVELOPMENT OF A REGULATION PLAN FOR THE GREAT LAKES, W70-00902 02H
CALIFORNIA STATE DEPT. OF WATER RESOURCES, SACRAMENTO. DESIGN OF CALIFORNIA AQUEDUCT, W70-01111	08A	DURHAM UNIV. (ENGLAND). DEPT. OF GEOGRAPHY. SOME THERMAL CHARACTERISTICS OF TWO RIVERS IN THE FENNINE AREA OF NORTHERN ENGLAND, W70-00881 05B
CALIFORNIA UNIV., RICHMOND. SEA WATER CONVERSION LAB. THE OPTIMUM TEMPERATURE FOR THE OPERATION OF A NON-SCALING MULTI-STAGE FLASH EVAPORATOR PLANT, W70-00907	03A	EBASCO SERVICES INC., NEW YORK. COOLING TOWERS FOR STEAM-ELECTRIC STATIONS - ECONOMIC APPLICATIONS, W70-00887 05D
CALIFORNIA UNIV., RIVERSIDE. EFFECTS OF EXTERNAL SALT CONCENTRATIONS ON WATER RELATIONS IN PLANTS SIGNIFICANCE OF EXTERNAL WATER-POTENTIAL AND SALT-TRANSPORT KINETICS ON RATE OF CELL EXPANSION, W70-01214	02I	ELECTRIC POWER DEVELOPMENT CO. (JAPAN) AND HITACHI LTD., HITACHI CITY (JAPAN). FIELD TEST RESULTS ON 113,000 KW FRANCIS PUMP-TURBINES FOR NAGANO POWER STATION, W70-01097 08C
CARNegie-MELLON UNIV., PITTSBURGH, PA. SYSTEMS PLANNING ASSOCIATES, PITTSBURGH, PA. AND WEATHER BUREAU, PITTSBURGH, PA. EVALUATION OF BENEFITS OF A FLOOD WARNING SYSTEM, W70-00838	06B	ENGINEERING-SCIENCE, INC., LOS ALTOS, CALIF. ANNOTATED BIBLIOGRAPHY ON HYDROLOGY AND SEDIMENTATION, 1963- 65, UNITED STATES AND CANADA. W70-00837 02J
CENTRAL GEOLOGICAL INST., BERLIN (EAST GERMANY). ON THE PRESENT OPTIMUM VARIANT IN HYDROGEOLOGICAL EXPLORATION (GERMAN), W70-01022	07C	EUROPEAN INLAND FISHERIES ADVISORY COMMISSION. WORKING PARTY ON WATER QUALITY CRITERIA FOR EUROPEAN FRESHWATER FISH. WATER QUALITY CRITERIA FOR EUROPEAN FRESHWATER FISH - WATER TEMPERATURE AND INLAND FISHERIES. W70-00880 05C
CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE, CHATILLON-SOUS BAGNEUX (FRANCE). CENTRE DE CALCUL ANALOGIQUE. NON-LINEAR FREE SURFACES IN OPEN CHANNELS (FRENCH), W70-00871	08B	FAUNA PRESERVATION SOCIETY, LONDON (ENGLAND). OIL POLLUTION OF THE SEA IS THE END IN SIGHT, W70-01230 05C
CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE, MARSEILLE (FRANCE) AND AIX-MARSEILLE UNIV. (FRANCE). INSTITUT DE MECANIQUE DES FLUIDES. A STUDY OF HOT WIRE AND HOT FILM ANEMOMETERS IN WATER (FRENCH), W70-00868	07B	FEDERAL WATER POLLUTION CONTROL ADMINISTRATION, CINCINNATI, OHIO. A COMPOSITE RATING OF ALGAE TOLERATING ORGANIC POLLUTION, W70-01233 05C
CHICAGO UNIV., ILL. DEPT. OF GEOGRAPHY. THE CHANGING ROLE OF WATER IN ARID LANDS, W70-01199	06B	FIELD STUDIES COUNCIL, PEMBROKE (ENGLAND). OIL POLLUTION RESEARCH UNIT. RECOVERY OF A SALT MARSH IN PEMBROKESHIRE, SOUTH-WEST WALES, FRCH POLLUTION BY CRUDE OIL, W70-01231 05C
CHICAGO UNIV., ILL. DEPT. OF THE GEOPHYSICAL SCIENCES. THE LAKE MISSOURIA FLOODS AND THE CHANNELLED SCABLAND, W70-01012	02J	FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS, BANGKOK (THAILAND). TRICKLE IRRIGATION -- A PROMISING SECOND TOOL FOR A BREAKTHROUGH IN FOOD PRODUCTION IN TROPICAL, SUBTROPICAL AND DESERT AREAS, W70-01218 03F
CLARK UNIV., WORCESTER, MASS. GRADUATE SCHOOL OF GEOGRAPHY. WEATHER PATTERNS IN SOUTHERN WEST PAKISTAN, W70-01197	02B	FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS, ROME (ITALY). EUROPEAN INLAND FISHERIES ADVISORY COMMISSION. WATER QUALITY CRITERIA FOR EUROPEAN FRESHWATER FISH LIST OF LITERATURE ON THE EFFECT OF WATER TEMPERATURE ON FISH. W70-01227 05C
COLORADO SCHOOL OF MINES, GOLDEN. DYNAMIC ASPECTS OF URBAN WATER DEMAND, W70-00899	06D	WATER QUALITY CRITERIA FOR EUROPEAN FRESHWATER FISH REPORT ON WATER TEMPERATURE AND INLAND FISHERIES BASED MAINLY ON SLAVONIC LITERATURE. W70-01228 05C
COLORADO STATE UNIV., FORT COLLINS. CHALLENGES TO CREATIVE CONSERVATION, W70-01081	06G	FOREST SERVICE (USDA), BERKELEY, CALIF. PACIFIC SOUTHWEST FOREST AND RANGE EXPERIMENT STATION. SOIL SLIPPAGE AN INDICATOR OF SLOPE INSTABILITY ON CHAPARRAL WATERSHEDS OF SOUTHERN CALIFORNIA,
COMMONWEALTH SCIENTIFIC AND INDUSTRIAL RESEARCH ORGANIZATION, CANBERRA (AUSTRALIA). DIV. OF PLANT INDUSTRY. HYDROSTATICS AND HYDRODYNAMICS IN SWELLING SOILS, W70-00841	02G	
A MODEL FOR RAINFALL ROUTING DURING INITIAL ABSTRACTION, W70-00844	02A	

ORGANIZATIONAL INDEX

FOR-LIE

W70-01196	02J	
FOREST SERVICE (USDA), FORT COLLINS, COLO. ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION. NOCTURNAL AIR TEMPERATURE ON A FORESTED MOUNTAIN SLOPE, W70-01219	02B	
FOREST SERVICE (USDA), PORTLAND, OREG. PACIFIC NORTHWEST FOREST AND RANGE EXPERIMENT STATION. INCREASES IN MAXIMUM STREAM TEMPERATURES AFTER SLASH BURNING IN A SMALL EXPERIMENTAL WATERSHED, W70-01220	07C	
FOREST SERVICE (USDA), SALT LAKE CITY, UTAH. ALTA AVALANCHE STUDY CENTER. STRENGTH TEST ON NEWLY FALLEN SNOW, W70-01221	07B	
GENERAL ELECTRIC CO., PHILADELPHIA AND FEDERAL WATER POLLUTION CONTROL ADMINISTRATION, PHILADELPHIA, PA. MATHEMATICAL SIMULATION OF THE ESTUARINE BEHAVIOR AND ITS APPLICATIONS, W70-00896	05C	
GEOLOGICAL SURVEY, DENVER, COLO. RECORDS OF SELECTED WELLS AND SPRINGS IN THE RULISON PROJECT AREA, GARFIELD AND MESA COUNTIES, COLORADO, W70-00987	07C	
GEOLOGICAL SURVEY, MENLO PARK, CALIF. FLUORESCENT SAND AS A TRACER OF PLUVIAL SEDIMENT, W70-00867	02J	
GROUNDWATER IN SANTA BARBARA COUNTY, CALIFORNIA, SPRING 1967 TO SPRING 1968. W70-00989	07C	
GEOLOGICAL SURVEY, MENLO PARK, CALIF. WATER RESOURCES DIV. EFFECT OF RAINFALL VARIABILITY ON STREAMFLOW SIMULATION, W70-C0850	02A	
GEOLOGICAL SURVEY, WASHINGTON, D.C. GEOLOGY, PETROLEUM DEVELOPMENT, AND SEISMICITY OF THE SANTA BARBARA CHANNEL REGION, CALIFORNIA, W70-00836	05E	
LAND SUBSIDENCE DUE TO GROUND-WATER WITHDRAWAL, TULARE-WASCO AREA, CALIFORNIA, W70-01013	02F	
FORMATION OF HYDROXY-AL AND -FE INTERLAYERS IN MONTMORILLONITE AND VERMICULITE INFLUENCE OF PARTICLE SIZE AND TEMPERATURE, W70-01014	02K	
GEORGIA INST. OF TECH., ATLANTA. THE RELATION OF ION MOVEMENT TO FINE PARTICLE DISPLACEMENT IN A SAND BED, W70-00909	05B	
RADIOTRACER STUDY OF RAPID SAND FILTRATION, W70-C0910	05D	
GIBB (ALEXANDER) AND PARTNERS, LONDON (ENGLAND) IMPERIAL COLL. OF SCIENCE AND TECHNOLOGY, LONDON (ENGLAND) AND BRISTOL UNIV. (ENGLAND). THE SEISMIC DESIGN STUDY OF A DOUBLE CURVATURE ARCH DAM, W70-01094	08A	
GLASGOW UNIV. (SCOTLAND). THE DEVELOPMENT OF THE IRRIGATION ECONOMY OF MENDOZA, ARGENTINA, W70-01213	03F	
HALLIBURTON CO., DUNCAN, OKLA. DEPT. OF CHEMICAL RESEARCH AND DEVELOPMENT. OIL FIELDS YIELD NEW DEEP-WELL DISPOSAL TECHNIQUE, W70-00990	05E	
HAWAII UNIV., HONOLULU. REGIONAL AND SEASONAL WATER SUPPLY IN THE TARIM BASIN AND ITS RELATION TO CULTIVATED LAND POTENTIALS, W70-01210	03P	
HAWAII UNIV., HONOLULU. WATER RESOURCES RESEARCH CENTER. A HYDROGEOPHYSICAL SURVEY FROM KAWAIHAO TO KAILUA-KONA, HAWAII, W70-00908	03B	
HAWKER SIDDELEY DYNAMICS LTD., HATFIELD (ENGLAND). EARTH RESOURCE SATELLITES, W70-01098	07B	
HEIDELBERG UNIV. (WEST GERMANY). SEDIMENT LAB. DIAGENETIC CHANGES IN INTERSTITIAL WATERS OF HOLOCENE LAKE CONSTANCE SEDIMENTS, W70-01009	02H	
HELSINKI CITY WATERWORKS (FINLAND). HYDRAULIC PROPERTIES OF SMALL UNLINED ROCK TUNNELS, W70-01115	08B	
HULL UNIV. (ENGLAND). COMMUNITY IRRIGATION PROJECTS IN THE WAIKERIE DISTRICT OF SOUTH AUSTRALIA, W70-01207	03P	
HULL UNIV. (ENGLAND). DEPT. OF GEOGRAPHY. WATER SUPPLIES IN SOUTH AUSTRALIA, W70-01204	03B	
HYDRONAUTICS, INC., LAUREL, MD. AN ESTIMATION OF WIND EFFECTS ON DISPERSION IN WIDE CHANNELS, W70-00842	02E	
HYDRO-ELECTRIC COMMISSION, TASMANIA. DECKED ROCKFILL DAMS, W70-01121	08D	
IDAHO UNIV., MOSCOW AND AGRICULTURAL RESEARCH SERVICE, KIMBERLY, IDAHO. SNAKE RIVER RESEARCH CENTER. FIELD EVALUATION OF SEEPAGE MEASUREMENT METHODS, W70-01236	04A	
IDAHO UNIV., MOSCOW. DEPT. OF BIOLOGICAL SCIENCES. A LIMNOLOGICAL COMPARISON OF TWO SMALL IDAHO RESERVOIRS, W70-01005	02H	
IDAHO UNIV., MOSCOW. WATER RESOURCES RESEARCH INST. TEMPORAL, HORIZONTAL AND VERTICAL VARIABILITY OF WATER CHEMISTRY IN UNSATURATED ZONE OF FINE-GRAINED SOILS, W70-00911	05B	
ILLINOIS GEOLOGICAL SURVEY, URBANA AND INDIANA UNIV., BLOOMINGTON. DISTINGUISHING MARINE AND FRESHWATER MUDS, W70-00994	02K	
ILLINOIS UNIV., URBANA. A LABORATORY STUDY OF SURFACE RUNOFF DUE TO MOVING RAINSTORMS, W70-00839	02A	
SPATIALLY VARIED FLOW EQUATIONS, W70-01003	02E	
ADVANTAGES AND LIMITATIONS OF THE OBSERVATIONAL METHOD IN APPLIED SOIL MECHANICS, W70-01092	08D	
IMPERIAL COLL. OF SCIENCE AND TECHNOLOGY, LONDON (ENGLAND) BINNIE AND PARTNERS, LONDON (ENGLAND) AND FAIREY SURVEYS LTD. (GR. BRIT.). PHOTOGRAMMETRIC MEASUREMENT OF ROCK SURFACES IN A POWER TUNNEL, W70-01090	07B	
INTERNATIONAL PACIFIC SALMON FISHERIES COMMISSION, NEW WESTMINSTER (BRITISH COLUMBIA). IMPLICATION OF WATER QUALITY AND SALINITY IN THE SURVIVAL OF FRASER RIVER SOCKEYE SMOLTS, W70-01225	05C	
IOWA STATE UNIV., AMES. STEADY FLOW OF WATER THROUGH A TWO-LAYER SOIL, W70-00840	02G	
IOWA STATE UNIV., AMES. DEPT. OF AGRONOMY. USE OF A SELECTIVE ION ELECTRODE FOR DETERMINATION OF NITRATE IN SOILS, W70-01075	05A	
IRRIGATION AND WATER SUPPLY COMMISSION, QUEENSLAND. FREQUENCY ANALYSES OF FLOODS AND DROUGHTS, W70-01120	02E	
KANSAS STATE UNIV., MANHATTAN. INST. FOR SYSTEMS DESIGN AND OPTIMIZATION. ANALYSIS AND OPTIMIZATION OF A REVERSE OSMOSIS PURIFICATION SYSTEM—PART II. OPTIMIZATION, W70-00890	03A	
KANSAS UNIV., LAWRENCE. DEPT. OF CHEMICAL AND PETROLEUM ENGINEERING AND KYOTO UNIV. (JAPAN). DEPT. OF CHEMICAL ENGINEERING. OPTIMIZATION OF THE ACTIVATED SLUDGE PROCESS—OPTIMUM VOLUME RATIO OF AERATION AND SEDIMENTATION VESSELS, W70-00893	05D	
KHARKOV STATE UNIV., (USSR). ON THE HYDROGEOLOGY OF THE CENTRAL AND NORTHWESTERN PART OF THE DNEIPEL-DONETS ARTESIAN BASIN (UKRAINIAN), W70-00866	02K	
KHARTOUM UNIV. (SUDAN). THE KHASH EL GIRBA IRRIGATION SCHEME A NEW SOCIO-ECONOMIC PROJECT IN THE SUDAN, W70-01208	03P	
KHARTOUM UNIV. (SUDAN). DEPT. OF GEOLOGY AND MISSOURI UNIV., COLUMBIA. DEPT. OF GEOLOGY. WATER-RETENTION CHARACTERISTICS OF COARSE ROCK PARTICLES, W70-00997	02G	
KHARTOUM UNIV. (SUDAN). DEPT. OF ZOOLOGY. THE DEVELOPMENT AND DISTRIBUTION OF PLANKTON IN THE NORTHERN PART OF THE WHITE NILE, W70-01007	02I	
LEEDS UNIV. (ENGLAND). PROPAGATION OF WAVE-FRONTS IN WIDE CHANNELS OF ARBITRARY CROSS-SECTION, W70-00872	08B	
LEHIGH UNIV., BETHLEHEM, PA. MARINE SCIENCE CENTER. CALCIUM CARBONATE INTERACTION WITH ORGANIC COMPOUNDS, W70-01069	02K	
LIEGE UNIV. (BELGIUM). EXPERIMENTAL RESEARCH ON SPILLWAY SHAFT FLOW (FRENCH), W70-00873	08E	

ORGANIZATIONAL INDEX

LIVERPOOL UNIV. (ENGLAND). CONVERGENT STILLING BASINS, W70-01099	08B	NORWEGIAN INST. OF SEAWEED RESEARCH, TRONDHEIM. STUDIES ON ALgal SUBSTANCES IN THE SEA. II. THE FORMATION OF GELBSTOFF (HUMIC MATERIAL) BY EXUDATES OF PHAEOPHYTA, W70-01072	05B
LONDON UNIV. (ENGLAND). SCHOOL OF ORIENTAL AND AFRICAN STUDIES. THE LAND AND WATER USE SURVEY OF NORTH-CENTRAL KORDOFAN (1961-66), W70-01198	03B	STUDIES ON ALgal SUBSTANCES IN THE SEA. I. GELBSTOFF (HUMIC MATERIAL) IN TERRESTRIAL AND MARINE WATERS, W70-01074	05B
LUND UNIV. (SWEDEN). GEOGRAPHICAL INST. GLACIAL HISTORY AND MORPHOLOGY OF WEST SWEDEN (SWEDISH), W70-00998	02C	OAK RIDGE NATIONAL LAB., TENN. RADIATION ECOLOGY SECTION. ESTIMATES OF PERIPHYTON MASS AND STREAM BOTTOM AREA USING PHOSPHONOUS-32, W70-00846	02I
MASSACHUSETTS INST. OF TECH., CAMBRIDGE. DEPT. OF MECHANICAL ENGINEERING. EXPERIMENTAL STUDY OF SLURRY SEPARATORS FOR USE IN DESALINATION, W70-00892	03A	OFFICE OF TRIBUTARY AREA DEVELOPMENT, KNOXVILLE, TENN. A WATER YIELD MODEL DERIVED FROM MONTHLY RUNOFF DATA, W70-00905	03B
MASSACHUSETTS UNIV., AMHERST. A SYSTEMS APPROACH TO WASTE MANAGEMENT, W70-00898	05D	OREGON STATE UNIV., CORVALLIS. MEASUREMENT OF COLUMBIA RIVER FLOW TIME FROM HANFORD REACTORS TO ASTORIA, OREGON-SUMMER 1966, W70-01002	02E
MICHIGAN UNIV., ANN ARBOR. LINEAR PROGRAMMING FOR HYDROLOGIC ANALYSES, W70-00999	02A	PENNSYLVANIA STATE UNIV., UNIVERSITY PARK. INST. FOR RESEARCH ON LAND AND WATER RESOURCES. WATER QUALITY AND REGIONAL ECONOMY, A DECISION MODEL, W70-00897	05G
MIDDLE EAST TECHNICAL UNIV., ANKARA (TURKEY). A SEMI-EMPIRICAL METHOD FOR DETERMINING STRESSES BEHIND EMBANKMENTS, W70-01102	08D	POLISH ACADEMY OF SCIENCES, KRAKOW. CAUSES AND CONSEQUENCES OF POND EUTROPHICATION (POLISH), W70-01082	05F
MINISTRY OF AGRICULTURE, FISHERIES AND FOOD, LONDON (ENGLAND). SALMON AND FRESHWATER FISHERIES LAB. THE DIURETIC RESPONSE BY RAINBOW TROUT TO SUB-LETHAL CONCENTRATIONS OF AMMONIA, W70-00848	05C	POLTEKHICHESKII INSTITUT, LENINGRAD (USSR). NEW PROBLEMS IN THE THEORY OF BOTTOM CURRENTS IN RESERVOIRS, W70-01129	08B
MINNESOTA UNIV., MINNEAPOLIS. RELATIVE DENSITY EFFECTS ON INCIPIENT BED MOVEMENT, W70-00865	02J	PRINCETON UNIV., N.J. DEPT. OF STATISTICS. FREQUENCY DISTRIBUTIONS OF STREAM LINK LENGTHS, W70-01006	02J
MISSISSIPPI STATE UNIV., STATE COLLEGE. DEPT. OF ZOOLOGY. PATTERNS OF INSECTICIDE RESISTANCE IN THE MOSQUITOFISH, GAMBUSIA AFFinis, W70-01226	05C	PUBLIC HEALTH SERVICE, WASHINGTON, D.C. CITY AIR - BETTER OR WORSE, W70-01239	05B
MONASH UNIV., CLAYTON (AUSTRALIA). DEPT. OF MECHANICAL ENGINEERING. MEASURING RAINFALL ON FOREST CATCHMENTS, W70-00843	02B	SOME OBSERVATIONS OF CLOUD INITIATION IN INDUSTRIAL AREAS, W70-01240	05C
MUNICIPALITY OF METROPOLITAN SEATTLE, WASH. AND METROPOLITAN ENGINEERS, SEATTLE, WASH. CADAD SYSTEM CONTROLS FOR REGULATION OF COMBINED SEWAGE FLOWS, W70-00889	05D	THE THERMAL CLIMATE OF CITIES, W70-01241	05B
NATIONAL AIR POLLUTION CONTROL ADMINISTRATION, RALEIGH, N.C. THE CLIMATE OF CITIES A SURVEY OF RECENT LITERATURE, W70-00988	10	RAND CORP., SANTA MONICA, CALIF. NEW WATER BIRD FOR EGYPT A ROBOT SHADDOF, W70-01205	03F
NATIONAL FERTILIZER DEVELOPMENT CENTER, MUSCLE SHOALS, ALA. FACTORS AFFECTING THE GROWTH OF NAJAS IN PICKWICK RESERVOIR, W70-01071	05C	RHODE ISLAND UNIV., KINGSTON. NARRAGANSETT MARINE LAB. THE INFLUENCE OF ALgal ANTIBIOSIS ON THE ECOLOGY OF MARINE MICROORGANISMS, W70-01068	05C
NATIONAL INST. FOR WATER RESEARCH, CONGELLA (SOUTH AFRICA). REGIONAL LAB. A RAPID FOR MEASURING THE ACUTE TOXICITY OF DISSOLVED MATERIALS TO MARINE FISHES, W70-00849	05A	STUDIES ON ALgal SUBSTANCES IN THE SEA. III. THE PRODUCTION OF EXTRACELLULAR ORGANIC MATTER BY LITTORAL MARINE ALGAE, W70-01073	05B
NATIONAL RESEARCH COUNCIL OF CANADA, OTTAWA (ONTARIO). WATER TEMPERATURE DURING THE MELTING OF LAKE ICE, W70-00852	02H	RIJKSUNIVERSITAIR CENTRUM TE ANTWERPEN (BELGIUM) AND GHENT RIJKSUNIVERSITEIT (BELGIUM). THE WATER-TABLE AQUIFER IN THE EASTERN COASTAL AREA OF BELGIUM, W70-00986	02F
NEBRASKA UNIV., LINCOLN. DEPT. OF HORTICULTURE AND FORESTRY. COMPUTER PROGRAM FOR PLOTTING TIME DEPENDENT DATA WITH INSTRUCTION AND EXAMPLES, W70-01008	07C	ROBERT S. KERR WATER RESEARCH CENTER, ADA, OKLA. MOVEMENT OF DDT AND NITRATES DURING GROUND-WATER RECHARGE, W70-00861	05B
NEVADA UNIV., RENO. DESERT RESEARCH INST. VALUATION OF A GROUNDWATER SUPPLY FOR MANAGEMENT AND DEVELOPMENT, W70-00904	04B	ROCHESTER INST. OF TECH., N.Y. OASES FOR THE FUTURE, W70-01203	06B
NEW BRUNSWICK UNIV., FREDERICTON. STRENGTH OF DISCONTINUOUS ROCKS IN DIRECT SHEAR, W70-01101	08E	ROCKWELL-DYNE, CANOGA PARK, CALIF. RESEARCH DIV. APPLICATION OF PYROLYtic GAS CHROMATOGRAPHY TO NATURAL WATERS, W70-00847	05A
NEWTON FISH TOXICOLOGY LAB., CINCINNATI, OHIO. CHRONIC TOXICITY OF ZINC TO THE FATHEAD MINNOW, PIMEPHALES PROMELAS RAPINESQUE, W70-01229	05C	RUHRVERBAND, ESSEN (WEST GERMANY). OXYGEN MANAGEMENT AND ARTIFICIAL REAERATION IN THE AREA OF BALDENNEY LAKE AND THE LOWER RUHR RIVER (IN GERMAN), W70-01224	05G
NEW YORK STATE UNIV., RALEIGH. GROUNDWATER MOVEMENT TOWARD ARTIFICIAL CUTS, W70-00858	02F	RUTGERS - THE STATE UNIV., NEW BRUNSWICK, N.J. WATER RESOURCES RESEARCH INST. WATER RESOURCES AND THE CHEMICAL INDUSTRY IN NEW JERSEY AN ECONOMETRIC AND ENGINEERING ANALYSIS, W70-01217	06D
NORTH DAKOTA STATE UNIV., FARGO. A PHYSICAL AND ECONOMIC ANALYSIS OF ALTERNATIVE IRRIGATION METHODS IN A SUB-HUMID CLIMATE, W70-01086	03F	SHEFFIELD UNIV. (ENGLAND). DEPT. OF GEOGRAPHY. THE ANALYSIS AND CLASSIFICATION OF SLOPE PROFILE FORMS, W70-01040	02J
NORTH TEXAS STATE UNIV., DENTON. WATER RESEARCH LAB. NITROGEN FIXATION BY GLOEOCAPSA, W70-01070	05C	SHELL DEVELOPMENT CO., MODESTO, CALIF. A LABORATORY INVESTIGATION OF BOREHOLE STABILITY, W70-01107	08E
SOIL CONSERVATION SERVICE, NEW SOUTH WALES. ESTIMATION OF GRAZING CAPACITY ON ARID GRAZING LANDS, W70-01206	03F	SOIL CONSERVATION SERVICE, NEW SOUTH WALES. ESTIMATION OF GRAZING CAPACITY ON ARID GRAZING LANDS, W70-01206	03F
SREDNEAZIATSKII NAUCHNO-ISSLEDOVATELSKII INSTITUT GEOFIZIKI I MIREHALNOGO SYRIA, TASHKENT (USSR). A SCHEME OF GEOTHERMAL WATERS OF CENTRAL ASIA (RUSSIAN), W70-00869	02F	SREDNEAZIATSKII NAUCHNO-ISSLEDOVATELSKII INSTITUT GEOFIZIKI I MIREHALNOGO SYRIA, TASHKENT (USSR). A SCHEME OF GEOTHERMAL WATERS OF CENTRAL ASIA (RUSSIAN), W70-00869	02F

STANFORD RESEARCH INST., MENLO PARK, CALIF. APPLICATION OF DYNAMIC PROGRAMMING TO THE CONTROL OF WATER RESOURCES SYSTEMS, W70-00903	06A	
STATE HYDROLOGICAL INST., LENINGRAD (USSR). PHYSICAL MODELING OF REGIME OF BODIES OF WATER TO STUDY THEIR SANITATION CONDITION (IN RUSSIAN), W70-00885	05B	
STATE UNIV. OF NEW YORK, SYRACUSE. WATER RESOURCES CENTER. EFFECT OF CHANGES OF STREAMFLOW REGIMEN ON RESERVOIR YIELD, W70-01001	04A	
STATE WATER PLAN DEVELOPMENT OF WATER RESOURCES MANAGEMENT, PRAGUE (CZECHOSLOVAKIA). SIMULATION OF RUNOFF FOR DESIGN OF WATER RESOURCE SYSTEMS, W70-00900	04A	
TECHNICAL UNIV. OF BUDAPEST (HUNGARY). DEPT. OF HYDRAULIC MACHINERY. DETECTION OF CAVITATION BY ACOUSTIC AND VIBRATION- MEASUREMENT METHODS, W70-00875	08B	
TECHNIK - ISRAEL INST. OF TECH., HAIFA AND WATER PLANNING FOR ISRAEL LTD., TEL AVIV. WATER SUPPLY SECTION. AQUEDUCT ROUTE OPTIMIZATION BY DYNAMIC PROGRAMMING, W70-00894	04A	
TECHNIK - ISRAEL INST. OF TECH., HAIFA. A CONJUNCTIVE OPERATION OF A SURFACE RESERVOIR AND A GROUNDWATER AQUIFER, W70-00906	02A	
TECHNIK - ISRAEL INST. OF TECH., HAIFA. SANITARY ENGINEERING LAB. EFFECT OF POLYELECTROLYTES IN CONJUNCTION WITH BENTONITIC CLAY ON CONTAMINANTS REMOVAL FROM SECONDARY EFFLUENTS, W70-00845	05D	
TECHNISCHE HOCHSCHULE, KARLSRUHE (WEST GERMANY). LEHRGEBIET FÜR INGENIEURBIOLOGIE. PHYSICAL AND BIOCHEMICAL ASPECTS OF BOD KINETICS, W70-01024	05C	
TERRATEST A.B., BROMMA (SWEDEN) AND SWEDISH GEOTECHNICAL INST., STOCKHOLM. ON A SOIL AND GROUND WATER INVESTIGATION WITH THE SHALLOW REFRACTION METHOD AT HO I RANA, W70-00995	07B	
TEXAS UNIV., AUSTIN. MODIFIED RUBEY'S LAW ACCURATELY PREDICTS SEDIMENT SETTLING VELOCITIES, W70-00855	02J	
THE ASWAN HIGH DAM, W70-01201	06B	
UNITED STATES LAKE SURVEY, DETROIT, MICH. TOTAL ALBEDO OF GREAT LAKES ICE, W70-00851	02C	
UNIVERSIDAD CENTRAL DE VENEZUELA, CARACAS. DEPT. OF ENGINEERING. ANALYTICAL SOLUTION FOR TURBULENT FLOW IN PIPES, W70-00870	08B	
UTAH STATE UNIV., LOGAN. ILLINOIS UNIV., URBANA AND COLORADO STATE UNIV., FORT COLLINS. A NUMERIC METHOD FOR ESTIMATING INFILTRATION, REDISTRIBUTION, DRAINAGE, AND EVAPORATION OF WATER FROM SOIL, W70-00862	02G	
VSESΟΥΖΝΥΙ НАУЧНО-ИССЛЕДОВАТЕЛЬСКИЙ ИНСТИТУТ ГЕОФИЗИЧЕСКИХ МЕТОДОВ РАЗВЕДКИ, МОСКОВ (УССР). THE RELATIONSHIP BETWEEN THE ULTIMATE RESISTIVITY OF CLAYEY SANDSTONES AND THEIR POROSITY AND CLAY CONTENTS (RUSSIAN), W70-00876	07B	
ESTIMATION OF CLAY CONTENT OF SAND FORMATIONS FROM WELL- LOGGING DATA (RUSSIAN), W70-00877	07B	
VSESΟΥΖΝΥΙ НАУЧНО-ИССЛЕДОВАТЕЛЬСКИЙ ИНСТИТУТ ГЕОФИЗИЧЕСКИХ МЕТОДОВ РАЗВЕДКИ, МОСКОВ (УССР). ON THE POSSIBILITY OF ESTIMATING THE THICKNESS OF UNCONSOLIDATED ROCKS BY VERTICAL ELECTRICAL SOUNDING IN PERmafrost AREAS (RUSSIAN), W70-00878	07B	
WASHINGTON UNIV., SEATTLE. DEPT. OF ZOOLOGY. SEASCNAL CHARACTERISTICS OF TWO SALINE LAKES IN WASHINGTON, W70-01076	02H	
SOME LIMNOLOGICAL FEATURES OF A SHALLOW SALINE MEROMICTIC LAKE, W70-01077	02H	
WATER RESOURCES ENGINEERS, INC., SPRINGFIELD, VA. STORAGE YIELD EXTENDING THE SEQUENT PEAK ALGORITHM TO MULTIPLE RESERVOIRS, W70-01000	06A	
WEATHER BUREAU, SILVER SPRING, MD. CONTINUOUS HYDROGRAPH SYNTHESIS WITH AN API-TYPE HYDROLOGIC MODEL, W70-00860	02A	
WEST VIRGINIA UNIV., MORGANTOWN. ON THE CONCEPT OF MEAN HYDRAULIC RADIUS, W70-01117	08B	
WESTERN WASHINGTON RESEARCH AND EXTENSION CENTER, PUYALLUP. PERSISTENCE OF DIAZINON AND ZINOPHOS IN SOIL EFFECTS OF AUTOCLOAVING, TEMPERATURE, MOISTURE, AND ACIDITY, W70-01079	02K	
WESTINGHOUSE ELECTRIC CORP., PITTSBURGH, PA. ELECTRICAL DESIGN OF PARAMETERS USED FOR EHV SYSTEMS, W70-01093	08C	
IMPROVED DIGITAL SIMULATION FOR ANALYZING POWER SYSTEM DISTURBANCES, W70-01105	08C	
ELECTRON BEAMS APPLY AN OLD PRINCIPLE TO MODERN ROCK- BREAKING, W70-01109	08H	
WORCESTER POLYTECHNIC INST., MASS. HEAD LOSSES CAUSED BY AN ICE COVER ON OPEN CHANNELS, W70-01126	08B	



ACCESSION NUMBER INDEX

05B	W70-00836	05B	W70-00911	02F	W70-00986	08B	W70-01061
02J	W70-00837	04A	W70-00912	07C	W70-00987	08B	W70-01062
06B	W70-00838	04A	W70-00913	10	W70-00988	05D	W70-01063
02A	W70-00839	04B	W70-00914	07C	W70-00989	08C	W70-01064
02G	W70-00840	05G	W70-00915	05E	W70-00990	08A	W70-01065
02G	W70-00841	06B	W70-00916	03B	W70-00991	08A	W70-01066
02E	W70-00842	06B	W70-00917	02E	W70-00992	08A	W70-01067
02B	W70-00843	06B	W70-00918	07C	W70-00993	05C	W70-01068
02A	W70-00844	06B	W70-00919	02K	W70-00994	02K	W70-01069
05D	W70-00845	06B	W70-00920	07B	W70-00995	05C	W70-01070
02I	W70-00846	04A	W70-00921	07B	W70-00996	05C	W70-01071
05A	W70-00847	04A	W70-00922	02G	W70-00997	05B	W70-01072
05C	W70-00848	05G	W70-00923	02C	W70-00998	05B	W70-01073
05A	W70-00849	05G	W70-00924	02A	W70-00999	05B	W70-01074
02A	W70-00850	05G	W70-00925	06A	W70-01000	05A	W70-01075
02C	W70-00851	05G	W70-00926	04A	W70-01001	02H	W70-01076
02H	W70-00852	06B	W70-00927	02E	W70-01002	02H	W70-01077
02I	W70-00853	04A	W70-00928	02E	W70-01003	05B	W70-01078
02B	W70-00854	04A	W70-00929	02D	W70-01004	02K	W70-01079
02J	W70-00855	06D	W70-00930	02H	W70-01005	02H	W70-01080
04A	W70-00856	06D	W70-00931	02J	W70-01006	06G	W70-01081
07B	W70-00857	06D	W70-00932	02I	W70-01007	05F	W70-01082
02F	W70-00858	05G	W70-00933	07C	W70-01008	05G	W70-01084
02F	W70-00859	06B	W70-00934	02H	W70-01009	06A	W70-01085
02A	W70-00860	06B	W70-00935	05C	W70-01010	03F	W70-01086
05B	W70-00861	06B	W70-00936	08D	W70-01011	04B	W70-01087
02G	W70-00862	04A	W70-00937	02J	W70-01012	04A	W70-01088
04A	W70-00863	06D	W70-00938	02F	W70-01013	07B	W70-01090
02J	W70-00864	06B	W70-00939	02K	W70-01014	08D	W70-01091
02J	W70-00865	04A	W70-00940	02B	W70-01015	08D	W70-01092
02K	W70-00866	04A	W70-00941	02B	W70-01016	08C	W70-01093
02J	W70-00867	04A	W70-00942	02A	W70-01017	08A	W70-01094
07B	W70-00868	06E	W70-00943	02C	W70-01018	08C	W70-01096
02F	W70-00869	06E	W70-00944	02J	W70-01019	08C	W70-01097
08B	W70-00870	06B	W70-00945	06E	W70-01020	07B	W70-01098
08B	W70-00871	06E	W70-00946	06E	W70-01021	08B	W70-01099
08B	W70-00872	06E	W70-00947	07C	W70-01022	06B	W70-01100
08B	W70-00873	06E	W70-00948	05D	W70-01023	08E	W70-01101
08A	W70-00874	05G	W70-00949	05C	W70-01024	08D	W70-01102
08B	W70-00875	06E	W70-00950	05A	W70-01025	05B	W70-01104
07B	W70-00876	06E	W70-00951	05B	W70-01026	08C	W70-01105
07B	W70-00877	04A	W70-00952	05D	W70-01027	04D	W70-01106
07B	W70-00878	04A	W70-00953	05G	W70-01028	08E	W70-01107
05D	W70-00879	04A	W70-00954	05A	W70-01029	08H	W70-01109
05C	W70-00880	04A	W70-00955	05A	W70-01030	08A	W70-01111
05B	W70-00881	04A	W70-00956	05C	W70-01031	08D	W70-01112
05C	W70-00882	04A	W70-00957	05C	W70-01032	08E	W70-01114
05D	W70-00883	05G	W70-00958	05B	W70-01033	08B	W70-01115
05D	W70-00884	05G	W70-00959	05G	W70-01034	08B	W70-01117
05B	W70-00885	05G	W70-00960	05G	W70-01035	08F	W70-01119
02H	W70-00886	04A	W70-00961	05A	W70-01036	02E	W70-01120
05D	W70-00887	04A	W70-00962	05C	W70-01037	08D	W70-01121
04A	W70-00888	04A	W70-00963	05A	W70-01038	03B	W70-01122
05D	W70-00889	04A	W70-00964	02F	W70-01039	02F	W70-01123
03A	W70-00890	04A	W70-00965	02J	W70-01040	08E	W70-01124
04A	W70-00891	04A	W70-00966	02J	W70-01041	07B	W70-01125
03A	W70-00892	06E	W70-00967	02J	W70-01042	08B	W70-01126
05D	W70-00893	06E	W70-00968	08A	W70-01043	08C	W70-01127
04A	W70-00894	06E	W70-00969	08A	W70-01044	07B	W70-01128
06E	W70-00895	06E	W70-00970	08B	W70-01045	08B	W70-01129
05C	W70-00896	04A	W70-00971	08B	W70-01046	05G	W70-01130
05G	W70-00897	06E	W70-00972	08B	W70-01047	04A	W70-01131
05D	W70-00898	04A	W70-00973	08C	W70-01048	03D	W70-01133
06D	W70-00899	06E	W70-00974	08B	W70-01049	06E	W70-01134
04A	W70-00900	06E	W70-00975	08B	W70-01050	04C	W70-01135
03B	W70-00901	06E	W70-00976	08A	W70-01051	05G	W70-01136
02H	W70-00902	06E	W70-00977	08A	W70-01052	06E	W70-01137
06A	W70-00903	06E	W70-00978	08A	W70-01053	04A	W70-01138
04B	W70-00904	06E	W70-00979	08A	W70-01054	06B	W70-01139
03B	W70-00905	06E	W70-00980	08B	W70-01055	06B	W70-01140
02A	W70-00906	06E	W70-00981	03C	W70-01056	06B	W70-01141
03A	W70-00907	06E	W70-00982	08A	W70-01057	06B	W70-01142
03B	W70-00908	06E	W70-00983	08A	W70-01058	04A	W70-01144
05B	W70-00909	06E	W70-00984	08C	W70-01059	04A	W70-01145
05D	W70-00910	06E	W70-00985	08B	W70-01060	04A	W70-01146

ACCESSION NUMBER INDEX

04A	W70-01147	05G	W70-01170	06E	W70-01193	03F	W70-01218
06E	W70-01148	05G	W70-01171	06E	W70-01194	02B	W70-01219
06E	W70-01149	05G	W70-01172	06E	W70-01195	07C	W70-01220
04A	W70-01150	05G	W70-01173	02J	W70-01196	07B	W70-01221
05G	W70-01151	05G	W70-01174	02B	W70-01197	08B	W70-01222
06E	W70-01152	06E	W70-01175	03B	W70-01198	08B	W70-01223
04A	W70-01153	06E	W70-01176	06B	W70-01199	05G	W70-01224
04A	W70-01154	04A	W70-01177	06D	W70-01200	05C	W70-01225
06E	W70-01155	04A	W70-01178	06B	W70-01201	05C	W70-01226
04B	W70-01156	06B	W70-01179	06D	W70-01202	05C	W70-01227
06B	W70-01157	04A	W70-01180	06B	W70-01203	05C	W70-01228
06B	W70-01158	05G	W70-01181	03B	W70-01204	05C	W70-01229
06B	W70-01159	04A	W70-01182	03F	W70-01205	05C	W70-01230
06E	W70-01160	04A	W70-01183	03F	W70-01206	05C	W70-01231
03E	W70-01161	04A	W70-01184	03F	W70-01207	05C	W70-01232
03E	W70-01162	06E	W70-01185	03F	W70-01208	05C	W70-01233
03E	W70-01163	04A	W70-01186	03F	W70-01210	04A	W70-01236
03E	W70-01164	06D	W70-01187	02J	W70-01211	02F	W70-01237
03E	W70-01165	06D	W70-01188	03F	W70-01213	04A	W70-01238
03E	W70-01166	06D	W70-01189	02I	W70-01214	05B	W70-01239
06E	W70-01167	06D	W70-01190	03B	W70-01215	05C	W70-01240
06E	W70-01168	05G	W70-01191	03B	W70-01216	05B	W70-01241
05G	W70-01169	06B	W70-01192	06D	W70-01217		

ABSTRACT SOURCES

Source	Accession Numbers	Total
A. Centers of Competence		
U.S. Geological Survey - Hydrology	W70-00836 -- 00879 00986 -- 01019 01022 -- 01042	99
University of Washington - Water Quality Requirements for Aquatic Organisms	W70-01225 -- 01233	8
University of Florida - Eastern U.S. Water Law	W70-00914 -- 00985 01130 -- 01195 00888, 00891 00895, 00912 00913, 01020 01021	143
Vanderbilt University - Thermal Pollution	W70-00880 -- 00887 01239 -- 01241	11
University of Wisconsin - Eutrophication	W70-01068 -- 01084	17
Bureau of Reclamation - Engineering Works	W70-01090 -- 01129 01218 01236 -- 01238	37
Cornell University - Policy Models for Water Resources Systems	W70-00889, 00890 00892 -- 00894 00896 -- 00907 01085	18
University of Arizona - Arid Lands Water Resources	W70-01196 -- 01216	19
Others:		
Federal Water Pollution Control Administration, (American Society of Civil Engineers)	W70-01043 -- 01067	25
Hawaii Water Resources Research Center	W70-00908	1
Georgia Water Resources Center	W70-00909 -- 00910	2
Idaho Water Resources Research Institute	W70-00911	1
North Dakota Water Resources Research Institute	W70-01086	1
Alaska Institute of Water Resources	W70-01087 -- 01088	2
New Jersey Water Resources Research Institute	W70-01217, 01224	2
Forest Service	W70-01219 -- 01221	3
Corps of Engineers	W70-01222 -- 01223	3
	Total	392

* Note: Numbers not used reduces totals where applicable.

Subject Fields

- 1 NATURE OF WATER
- 2 WATER CYCLE
- 3 WATER SUPPLY AUGMENTATION AND CONSERVATION
- 4 WATER QUANTITY MANAGEMENT AND CONTROL
- 5 WATER QUALITY MANAGEMENT AND PROTECTION
- 6 WATER RESOURCES PLANNING
- 7 RESOURCES DATA
- 8 ENGINEERING WORKS
- 9 MANPOWER, GRANTS, AND FACILITIES
- 10 SCIENTIFIC AND TECHNICAL INFORMATION

INDEXES

- SUBJECT INDEX
- AUTHOR INDEX
- ORGANIZATIONAL INDEX
- ACCESSION NUMBER INDEX
- ABSTRACT SOURCES

U.S. DEPARTMENT OF COMMERCE
CLEARINGHOUSE FOR FEDERAL
SCIENTIFIC AND TECHNICAL INFORMATION
Springfield, Va. 22151

OFFICIAL BUSINESS

LIBRARY RATE
PRINTED MATTER



POSTAGE AND FEES PAID
U.S. DEPARTMENT OF COMMERCE